SCIENTIFIC AMERICAN

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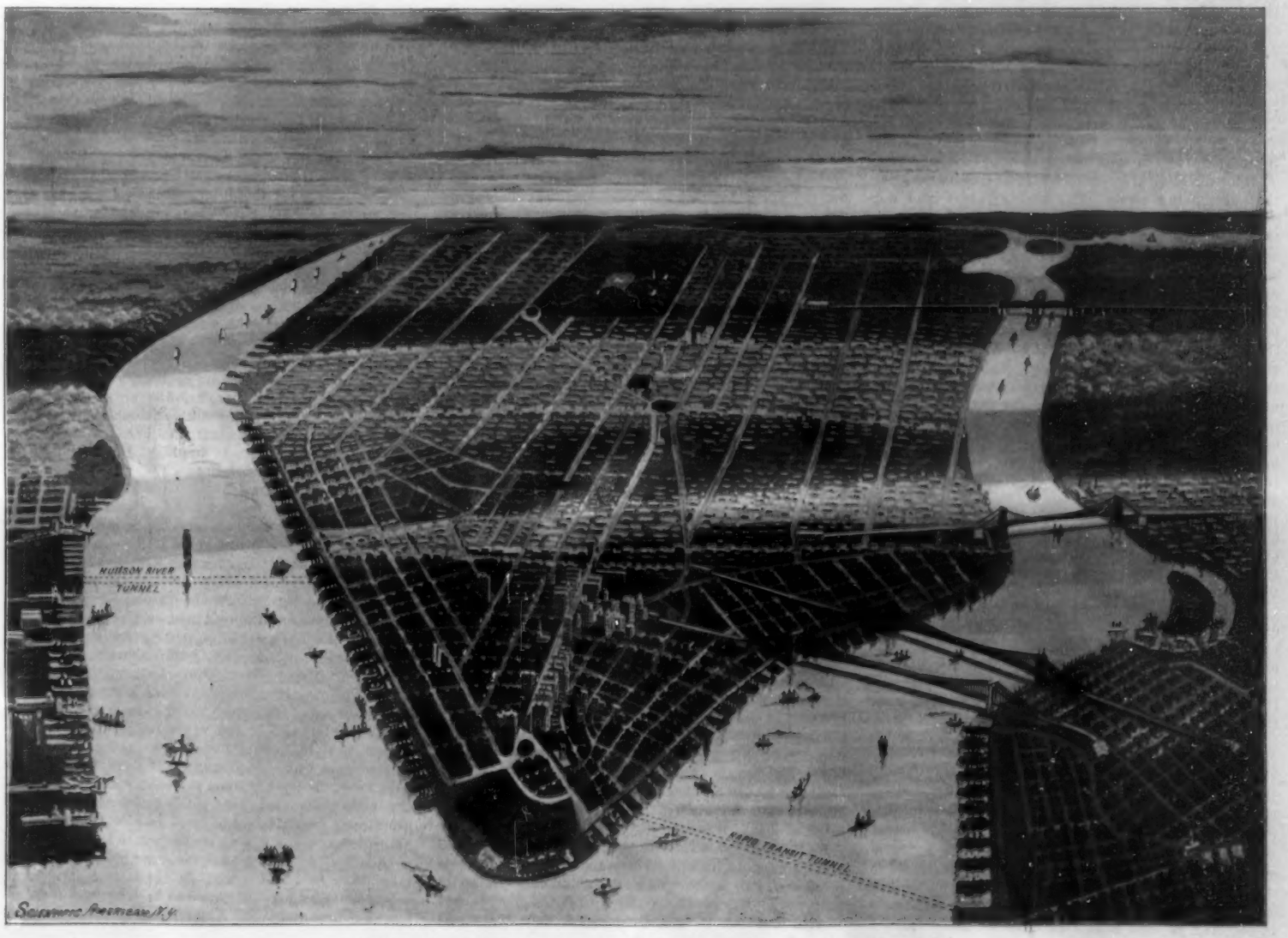
THE BROOKLYN BRIDGE AND SUSPENSION BRIDGE. No. 3, ON WHICH WORK HAS JUST COMMENCED.



BIRD'S EYE VIEW OF NEW YORK, SHOWING THE BRIDGES BUILT AND BUILDING ACROSS THE EAST RIVER.—[See page 70.]

Scientific American.

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NEW YORK, SATURDAY, AUGUST 3, 1901.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

FUTURE RECONSTRUCTION OF THE BROOKLYN BRIDGE.

In another column will be found an explanation of the causes which led to the recent partial failure of the Brooklyn Bridge. Our readers will probably agree with us that the collapse was due to indifferent construction, coupled with an inspection which, to say the least, was not any too thorough. The system of connecting the suspenders to the floor is poor and liable to introduce strains for which the parts were not proportioned. In the general reconstruction of the floor system of the bridge which undoubtedly will have to be undertaken at the earliest opportunity, the design of this detail of the bridge must be radically altered. It is manifestly difficult to hang a massive floor having a total horizontal movement of 14 inches to a cable which has practically no horizontal movement, by hinged connections which are only 20 to 24 inches in length. The best thing to do would be to make the trusses continuous across the center of the bridge and cut them either where the overhead diagonal stays commence, or else at the towers. The first would be a preferable position for the slip joints, for the reason that the fixed overhead stays form with the floor system a kind of cantilever construction, and the central portion of the span between them would thus act somewhat as the central supported span of a true cantilever bridge. There would be no difficulty in making connections between the suspenders and the floor system, at these points in the bridge, the great length and the flexibility of the former precluding any necessity for hinged connections.

The recent accident will serve the good purpose of forcibly directing attention to the fact that the bridge is carrying heavier loads than are desirable. This is the second occasion on which this condition of things has caused failure of the bridge. Two or three years ago it was manifested by the buckling of the stiffening trusses. Now it is the suspenders that are giving away. The first accident was not nearly so serious as the second; but they both show that there are weak places in the floor system which only require an extra bunching of the traffic, or the combination of excessive movement of the trusses with rather careless maintenance, to produce a breakdown. The main cables and the suspenders themselves when properly connected up and cared for are sufficient for the loads which the bridge is carrying, but the stiffening trusses are altogether too light to give the necessary rigidity to the structure. There is no question that the time has come for putting in more modern and stronger trusses, even if it should involve an increase in weight and the substitution of heavier suspenders for those which are now in place. We think it is quite within the resources of modern engineering to carry out this reconstruction, piecemeal, without interfering with the traffic. If this should be impossible, advantage will have to be taken of the completion of the new East River Bridge and of the ferries, to which traffic will have to be diverted while the change is being made.

The recent closing of the bridge and the enormous discomfort thereby occasioned are another reminder of the fact that the city authorities have ever been slow to realize the enormous and ever-accelerating rate at which the city of New York is growing, and its traffic requirements multiplying. We have seen this illustrated in the matter of the water supply, in the matter of the Rapid Transit tunnel, in the inadequate provision for public schools, and in other directions where the inconvenience, while not so widely felt, was, nevertheless, equally real. Those who are intrusted with the care of the city's interests, plan and build for an increase in the municipal demands of the city which, by the time the improvements are ready, is found to be immeasurably above the estimate. The Ramapo affair, bad as it was, has surely served the purpose—at least we hope it has—of teaching us that it is high time we made further and very much more extensive arrangements for securing an adequate water supply. The present overcrowded condition of the Brooklyn Bridge, and the fact that this splendid structure has been loaded up to, and almost beyond the safe limit imposed by good engineering, is another object lesson to the same effect. We sincerely hope that the new East River Bridge will be rushed to completion, and Suspension Bridge Number Three prosecuted with a speed that is commensurate with the urgent needs of traffic between Manhattan and Brooklyn. Bridge work is of necessity, because of its size and mass, slow in construction, and it is far better to be a little beforehand than very much behindhand in works of this kind.

RECENT DEVELOPMENTS IN THE BRITISH NAVY.

BY OUR ENGLISH CORRESPONDENT.

The energetic and progressive policy of the British Admiralty is being maintained in view of the keenness that is being exhibited by the various Continental powers in the struggle for the supremacy of the seas. The Naval Department has recently decided upon its new naval programme, and it is of a most extensive character. In the selection of this programme the experience and suggestions of naval officers and experts in the fleet were obtained, so that the Admiralty might gain a comprehensive insight into the defects of the existing vessels and consider suggested improvements. These suggestions have been adopted with liberality in the designing of the new vessels.

In connection with the first class battleships a new type of this class of vessel is to be built, exceeding in armament any other vessel afloat or in course of construction for the English navy and equal in every respect to the vessels designed for any other of the powers. These new battleships, three of which are to be laid down immediately, are to be of 16,500 tons displacement. This exceeds the previous latest battleships by 1,500 tons. They will be 20 feet longer, being 420 feet over all, with a beam of 75 feet and a draught of 26¾ feet. Their engines will develop 18,000 I. H. P. and they will run on an eight hours continuous steam trial at not less than 18½ knots, an increase of ½ knot.

Their protection will be similar to that of the recent "London" class of battleships, with several developments, including an armored belt from the lower protected deck to a small height above the water line of 9-inch armor, and thence to the main deck of a thickness of 8 inches, and this will be continued over the whole length between the barbette and the heavy guns.

A peculiar feature will be introduced which has not hitherto been attempted in any English vessels. The plan of placing the 6-inch guns in casemates is to be abandoned. The ten guns of this caliber will be inclosed in a battery with 7-inch armor, and the battery will be divided by traverses to diminish the effect of any shell that may happen to penetrate the armor. In addition to the four 12-inch guns which form the normal armament of this type of battleship throughout the world, four 9.2-inch guns are to be introduced. These guns are of tremendous power and will considerably strengthen the armament of the vessel. They will be placed on mountings similar to those which have been recently placed on the "Cressy" and which have proved so conspicuously successful. They will be protected by 6-inch or 7-inch armor, and will have a direct forward and aft fire. By this means the ship will get a forward fire of two 12-inch, two 9.2-inch and two 6-inch guns, and an aft fire of the same formidable character. This means that presuming all the guns to be fired simultaneously an aggregate weight of 2,660 pounds of metal—nearly 1¼ tons—will be fired from the six guns fore and aft respectively.

A new type of cruiser has been designed. This new vessel, of which six are to be laid down, will be of 9,800 tons, 22,000 I. H. P., developing a speed of 23 knots. Instead of carrying two 6-inch guns, both fore and aft, which comprises the armament for these vessels already on service, one 7.5-inch gun will be placed fore and aft. There is a great material increase in the power of this larger caliber gun which will render the armament of a very superior character.

With regard to the destroyers, ten are to be built which at full draught will have a speed of 30 knots. One important improvement in this type of vessel will be the increase in the coal-carrying capacity.

Several vessels have been struck off the effective list and will be used simply as depots. Eight vessels which the Admiralty decided to refit have been abandoned in lieu of new ships. The present programme for building comprises 18 first-class battleships, 25 armored cruisers, 25 torpedo boats, making in all, with several other vessels for different purposes, a total of 84 new ships.

Building in the various shipyards, both governmental and private, is in full swing, and rapid headway is being made to make up for the delay in building in past years. Many of the larger private yards have carried out extensive improvements and alterations and have installed new plants in order that they may cope with the work.

The fittings of the new vessels are to be of a most up-to-date and modern description. They will be provided with the most approved ammunition, the guns will have cordite charges and telescopic sights, electric hoists, and the latest types of torpedoes.

Owing to the importance of specially equipped coaling vessels the Admiralty proposes devoting $400,000 for this type of ship, and at present there are seven fast steamers plying at home and abroad for supplying the vessels of the fleet with coal. Coal barges to be used as temporary transmitters are to be fitted in order to be available for getting coal on board ships not lying at the wharves. A new distilling ship has been provided, and large distilling apparatus is being installed at all the stations, so that an abundant supply of fresh water is always available. The construction of an ammunition ship is also under consideration, but, owing to the difference of opinion among experts concerning the advisability of such a vessel, it has not been definitely settled.

The trials respecting the boilers are also being pushed forward. Experiments are being made in all directions to ascertain which type of boiler is the best suited for naval requirements. The installation of the Belleville boiler has been stopped, pending the decision of the investigating committee, and orders have been placed for one or two of the Babcock & Wilcox water-tube boilers. The German naval authorities are also conducting similar boiler tests, and they are also experimenting with a combined installation of water-tube and cylindrical boilers upon some of the battleships. If this scheme is feasible and proves successful, it will probably be adopted in the English battleships.

It has also been decided to decrease the height of the masts of the new battleships. Owing to the fact that signaling has been revolutionized by Marconi's wireless telegraphy, it is considered unnecessary to have lengthy masts, as nearly all the vessels in the English navy are being provided with Marconi's apparatus. Probably as much as 60 feet will be cut off from the masts. Hardly any wood is to be employed in construction, and that utilized in the shape of furniture and fittings will be arranged so that it can be thrown overboard within a few minutes, owing to the great danger of ignition that arises from its presence.

The system of building fore-and-aft bridges at present in vogue will be discontinued. Small unobtrusive structures will be provided in their stead, and although made of steel they will be rendered easily removable so that they can also be quickly thrown overboard. These improvements will somewhat detract from the beauty and symmetry which has hitherto characterized the British ships; but a great deal of conspicuous superstructure will be removed, so that when cleared for action the vessel will not offer so conspicuous a target.

ELECTRICAL METHOD FOR DETERMINING THE VARIATIONS OF MINERAL WATERS.

A simple and rapid method of finding out the variations in composition of mineral waters has been brought out by M. P. Muller, who uses the variations in electric conductivity for the purpose. To make a complete study of a given mineral water and establish its qualitative and quantitative composition, chemical analysis is indispensable, and of course cannot be replaced; but the composition of a water is not necessarily invariable, and one cannot be sure whether a certain spring of mineral or ordinary drinking water, when analyzed in the month of January, will have the same composition in the month of June, or in the following year. The chemical analyses would be long and costly, nevertheless it would be interesting to be able to follow the variations of a spring from the time when an analysis had been made, and to know the influence of the seasons or of a change of flow due to rains or dry weather; also the modifications due to an infiltration which may be unknown. A method of indicating such variations should be simple, rapid and easy to carry out, and besides, the property which it is proposed to measure should depend as much as possible upon the dissolved matter and not upon the water itself. The method of electric conductibility fulfills these conditions very well. The experiment is made promptly by the method of alternating currents and telephone (a greater or less sound indicating greater or less conductivity), but care should be taken to operate always at the same temperature, say, 25 deg. C. The conductivity of a water defines this liquid in the same way as a fusing point defines a chemical substance; it depends upon the nature and quantity of the substances dissolved, which in a potable water are almost exclusively composed of electrolytes. It is natural that two different waters which have the same conductibility may not have the same composition, any more than two bodies with an identical fusing point would be alike, but to follow the variations of a determined source the value method cannot be questioned.

One may even go farther; if two neighboring springs flowing from the same geologic earth, seemingly independent, show the same conductibility, it may be safe to affirm that they are identical. The author, after two experiments requiring half an hour, predicted the identity of two such springs which passed for distinct, and a subsequent chemical analysis showed an almost complete identity, the only divergence being that for the silica and oxide of iron (present only in minute quantity), and it is known that these substances exist in the waters almost entirely in the colloidal state and non-conductor. In another case he showed considerable variations in the composition of a mineral spring of which an analysis was about to be commenced, and made it evident that such an analysis would have no value.

NATIONAL PHYSICO-TECHNICAL LABORATORIES.*

BY H. PELLAT, PROFESSOR AT THE UNIVERSITY OF PARIS.

Industry is making an increasing demand on science, not only for its discoveries, but for the exactness of its measuring processes; it depends upon the precise data found in the laboratories. If the largest companies can support the expense of testing or research laboratories and have a personnel of engineers and scientists, the greater part of the manufacturers cannot go to this expense, especially for the tests relating to physical measures, which most often demand very costly apparatus. Even the scientists cannot have in their laboratories all the apparatus necessary for the verification of measuring instruments, as many of these are cumbersome and of a very great cost. For this reason, some of the governments have aided their manufacturers and scientists by establishing national physico-technical laboratories provided with the most improved measuring instruments where verifications of great precision and useful researches are carried on, these being of benefit to science and industry. Germany has commenced this movement, and possesses now in the Physikalisch-technische Reichsanstalt, founded about 1890, the most important of the national physico-technical laboratories. This establishment, situated at Charlottenburg, near Berlin, occupies an immense edifice which has been especially built for the purpose, in the middle of a park, which is an excellent position to guard the instruments from trepidations. The director has under his orders a corps of eighty persons. The Reichsanstalt is divided into two sections. The first has for its object the solution of problems of metrology proper; it is occupied with problems of a high interest and has especially rendered service to pure science. For instance, its researches have related to the normal thermometric scale, the rotative power of quartz for the light of sodium, the standard of resistance, etc. It also makes determinations of the unknown or ill-defined physical constants of bodies presenting a scientific or industrial interest. It is thus that during 1898 this section took up the study relative to the density of water vapor between 1 and 20 atmospheres to the maximum pressure of water vapor at low temperatures, the comparison of thermometric bodies with the normal thermometer at high temperatures, the heat conductibility of several metals, the luminous radiations emitted by certain substances, etc.

The second section, the most important of the two as far as the personnel is concerned, is charged with verifying the instruments of precision and the measurement of certain physical properties which have a less scientific character than those of the first section. The section is subdivided into six sub-sections, whose names indicate their field of work: 1. Mechanics of precision. 2. Electric measurements. 3. Optical measurements. 4. Thermometric measurements. 5. Chemical work. 6. Workshop. An example may be given by a resumé of the work done in the space of one year by the first and fourth sub-sections. The first, with three workers, has made about 200 researches relative to the determination of the errors of division of various scales, to the measurement of exterior dimensions of calibrated pieces, to the evaluation of the dilatation coefficient of metallic rods, the verification of tuning-forks, etc. The fourth sub-section, with seven workers, has verified 16,329 thermometers, including 14,910 medical, 81 apparatus for determining the inflammability of petroleum, 116 viscosimeters, 4 pressure gages, 35 barometers, 116 thermo-elements of the Lechatelier type and 400 feet of wire for the same, 50 fusible safety-plates for boilers, and has made besides a number of different tests. The verification of alcohol and density gages, etc., has remained in charge of an older institution known as the Normal Aichungs Kommission, and which verifies also the secondary standards for weights and measures.

England has already three standardizing establishments. Two of these are under the direction of the Board of Trade. The first, the Standards Department, has had the keeping of the standards (length, weight, money, gas meters, petroleum inflammation apparatus, etc.) and makes comparisons with these standards. It is besides at the disposition of the Board of Trade for all the scientific researches which it may require. The second, the Electrical Standardizing Laboratory, founded according to the law of 1889, is devoted to standardizing and verifying all the electrical measuring instruments and the keeping of the standards for these. Besides these two official laboratories there is a semi-official laboratory, the Kew Observatory. Besides the meteorological service, this establishment has, in fact, a standardizing laboratory, where each year are verified about 30,000 instruments of different kinds, such as thermometers, barometers, theodolites, sextants, compasses, telescopes, watches and chronometers, photographic lenses, etc. Not content with these three establishments, the government is now founding a national physical laboratory upon the plan of the German institution. Parliament has voted the necessary funds for its construction and maintenance; into it will be absorbed the Kew Observatory.

In Belgium, the founding of a Meteorological Bureau, distinct from the Bureau of Standard of Weights and Measures, and closely resembling the Reichsanstalt in character, was decided eight years ago; various circumstances have retarded up to the present the voting of the necessary funds, but it is expected that this vote will take place before the end of this year. In Russia, the Central Chamber of Weights and Measures possesses vast laboratories very well fitted up, and its extensive functions permit it to render in part the same services as a physico-technical laboratory. This chamber has, in fact, the following functions: 1. The keeping of the prototype of the Russian standards of weights and measures. 2. The making and verification of the copies of these standards made for the use of local standardizing bureaus or for the government bureau. 3. The verification of all special instruments serving to measure the temperature, light intensity, consumption of gas or electric energy, etc., and in general it verifies upon demand all the measuring instruments in use in commerce, industry, arts or sciences. 4. The fixing of the limits of error admissible for the weights and measures, in standardizing and in practical use. 5. The examination of all questions relating to weights and measures. 6. The direction of the local bureaus, etc. The chamber occupies at St. Petersburg a solid building of three stories, situated in the middle of a large space; a pavilion for electrical measures is shortly to be added. The establishment is provided with a complete assortment of the best meteorological apparatus existing. An idea of its importance will be given when it is stated that its personnel consists of fourteen persons, not including laboratory assistants, etc., and that its annual budget is about $46,000. It is under the control of the Department of Commerce and Manufactures of the Minister of Finance. The chamber is not the only standardizing establishment which Russia possesses; the instruments which serve for determining the tax upon certain substances are verified by the Technical Committee, which has this in charge; it is also under the Minister of Finance. In consequence, the Technical Committee is required to verify the alcohol and density instruments, thermometers, saccharimeters, etc. For the alcohol measures a special section is devoted, and it is provided with standards of length and weight verified at the International Bureau of Weights and Measures and the most improved apparatus. This section occupies a separate building at St. Petersburg. Again, the Central Physical Observatory of the Imperial Academy of Sciences also verifies metrological instruments.

In other European countries there are no national physico-technical laboratories and the functions of the service of weights and measures are in general much too limited to supply their absence. Nevertheless, in Austria the Normal Aichungs Kommission has about the same functions as in Germany, being devoted to verifying measures and weights, thermometers, etc. In the United States the principal cities possess, in their universities and colleges, splendidly organized laboratories where are carried out the tests and standardizing needed in the sciences and industry.

In concluding his address, M. Pellat points out the immense advantages of such institutions and the desirability of founding them in countries which, like France, do not yet possess them. As in the case of Germany and England, such a laboratory should be independent of the Bureau of Weights and Measures, as each responds to a different need. The buildings should be away from the centers of cities to avoid trepidations.

* Lecture delivered before the Congres de Physique. Reported by special Paris Correspondent of the SCIENTIFIC AMERICAN.

THE WORK OF THE EGYPTIAN EXPLORATION FUND.

BY OUR ENGLISH CORRESPONDENT.

The annual exhibition of the year's work of the Egypt Exploration Fund was held recently in London. The investigations of Egyptologists during the years 1899 and 1900 were productive of much interesting information regarding the kings of the First Dynasty, approximately 4715 to 4514 B. C., and "the Ten Kings before Menes." Mr. Maciver, who has explored two large cemeteries at El Amrah, states as the result of his researches that one of them belongs to the first half of that remote age and the second extends from the First Dynasty. Hitherto our information concerning this period has been very vague, so that additional interest and value attaches itself to this Egyptologist's investigations in this direction. There were on exhibition models of the bracelets found on the mummy of the Queen of Zer at El Mehesna and now jealously preserved in the museum at Cairo. There are four bracelets in all, the first consisting of a row of façades with the royal hawk alternately reproduced in gold and turquoise. The second has a gold centerpiece copied from the center of a lotus flower with a group of turquoises and a large ball amethyst on each side. Skillfully woven into the back of this bracelet are strands of human hair and gold thread set with gold and turquoise. The third bracelet is of gold, lapis lazuli, and amethyst beads. The work is beautifully executed, each bead having its precise position in the scheme of decoration, while there is no excess of color. There is also the scepter of King Khasekhemul, comprising a slender copper rod with pierced cylinders of sardonyx or carnelian united by broad and heavy gold bands strung over it, bead-wise. From El Amrah were exhibited specimens of prehistoric pottery, dolls, and primitive and crude models in clay of various animals. The excavations at Abydoes and the surrounding neighborhood are now practically completed and this collection of ancient handiwork is further valuable, since this district was supposed to have been thoroughly explored some time before, but the work on that occasion was but indifferently accomplished, without the assistance of trained workmen, which has enabled the present explorations to be carried out so thoroughly and systematically.

SCIENCE NOTES

The Government is constructing a new machine for calculating the tides which, it is said, will do the work of thirty mathematicians. The most complicated problems of tidal variations are easily worked out with it.

The exhibits of agatized wood in the Mines Building of the Pan-American Exposition is very important. It is generally conceded that this agatized wood came from a tropical tree transformed in a prehistoric era from a living, growing forest to its present state. Silicified wood is found in many localities, but the coloring of this wood has never been equaled.

Prof. Koch, of Berlin, who discovered the bacilli of phthisis, stated at the Tuberculosis Congress at London that he had demonstrated that meat and milk from tuberculosis-infected cattle may be consumed with absolute impunity. He has arrived at this conclusion after most practical tests. He believes that human and bovine tuberculosis are of a totally different species, and that phthisis is not hereditary. The discovery is of the utmost importance, especially as regards milk. His views are warmly combated by other medical men.

Dr. Barton's war balloon is of cigar shape, and has a platform and machinery suspended from the balloon. The propellers are driven by a high speed motor, and there is a horizontal aeroplane for causing the balloon to ascend and descend, and at the rear there is a vertical aeroplane steering to the right and left. The difficulty which arises from moving the center of gravity is overcome by 2½-foot water tanks at each end, water being automatically pumped from one to the other as either end of the machine becomes heavier.

Alcohol is made in solid form by heating a liter of it in a vessel of double capacity over a water bath at a temperature of 60 deg. C. Twenty-eight to thirty grammes of Venetian soap, very dry and cut fine are added, as well as two grammes of gum lac. After a complete solution has been obtained, and while it is still warm, it is poured into metallic receptacles which are closed immediately and left to cool. The presence of the gum lac assures the preservation of the material and prevents too quick evaporation. The soap incorporated in the alcohol is left as a residue after burning.

John Arbuckle, of Brooklyn, has started a novel floating hotel enterprise. It consists of a small fleet of especially equipped ships which will carry people on short ocean cruises, the vessels being run as floating hotels. The vessels leave late in the afternoon, put out to sea and remain outside until early morning. The fleet consists of a thousand-ton sailing ship, a yacht, an ex-pilot boat and an ocean tug. The large sailing ship is a full-rigged three-master and has accommodations for 250 passengers. The upper deck, which is protected by a watertight awning, is fitted with bunks, and there are also bunks surrounding the dining room deck. There are a considerable number of staterooms in addition, and many of them are provided with bathtubs.

BABY INCUBATORS AT THE PAN-AMERICAN EXPOSITION.

Statistics show that only about 25 per cent of the infants prematurely or weakly born live ordinarily, but by means of the baby incubator of to-day the lives of about 85 per cent are saved. The baby incubator exhibited at the Pan-American Exposition is in a special building on the Mall near one of the entrance gates, and while it is in the nature of a concession, or in other words an exhibit, it has proved to be of great interest to visitors. In a large room, well-lighted, are a dozen incubators, each of which consists of a glass case in a metal frame, and supported on metal legs. In each is a small woven-wire cot carefully padded. Fresh air is admitted by a large pipe from outside the building. The air passes first through an antiseptic fluid which destroys any germs that may be lurking in it. It also passes through cotton, which filters out any physical impurities. The air is then warmed and is finally introduced into the chamber where the baby lies. A pan of warm water keeps the atmosphere humid and the amount of moisture is registered by a small hygrometer at one side of the incubator. The air enters at the bottom of the case, strikes a shield below the cot and is deflected downward until it meets the warm current of air heated by a Bunsen burner placed outside the case. The temperature is automatically regulated by a thermostat. At the side of each case is a small boiler which holds about two gallons of water. Through the proper introduction of cold water the circulation is controlled in the pipes that heat the incubator in the same manner in which it is done in a house heated by hot water. A centigrade thermometer in front of each incubator gives the actual temperature all the time. Each infant is swathed, German-fashion, and they can be clearly seen through the glass doors and sides of the various incubators. The infants are sent by the physicians of Buffalo and are given over to the care of the institution. They are weighed, clothed and placed in the incubator. They are usually under five pounds in weight on admission. The babies are taken out of the incubators every two hours to be fed by the nurses who live in the building.

At the rear of the incubator room is a model nursery, which is shown in one of our engravings. A miniature elevator takes the infants to the upstairs quarters to be fed. Most of the babies lie with their eyes closed, and practically the only sign of life is the occasional flutter of one of the tiny hands. In accordance with the European custom the boys are distinguished by blue ribbons and the girls by pink. The infants at the Exposition are not from institutions, but are from private families, so that the names of the little patients are carefully kept from the public. Above each incubator is a card on which is given the child's initials, the date of its birth, its admission to the incubator, the circumstances that makes artificial care advisable, its weight and any other detail of significance. The incubator was invented about sixty years ago, but it never came into general use until 1878, when incubators were installed at the Paris Maternity Hospital. Both Berlin and London have permanent institutions similarly equipped and in successful operation.

MODEL NURSERY AND ELEVATOR FOR INFANTS

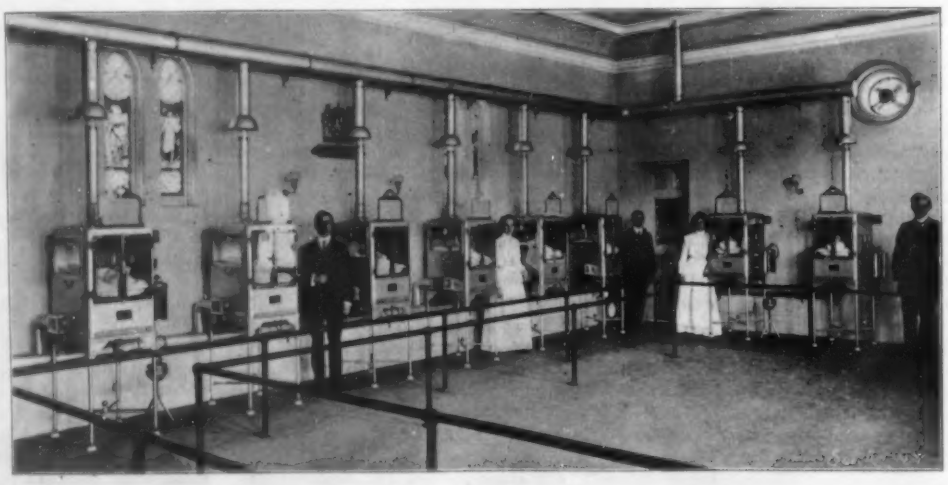
WEIGHING AN INFANT.

The Question of the Alcohol Motor.

Now that the question of the alcohol motor is receiving great attention, it may be interesting to note the resumé of the subject which M. Gustave Chauveau, a prominent engineer, presents in Le Chauffeur. According to M. Chauveau, the situation of the alcohol motor question may be summed up as follows. Scientifically speaking, there exist two opposite parties, the anti-alcoholists and the pan-alcoholists. The former hold that the motor used being the same as that for gasoline, its thermic efficiency should be sensibly the same, and in consequence the relation between the respective consumption of gasoline and alcohol for the same power should be virtually equal to that of the calorific power of these combustibles. Gasoline gives about 11,000 calories per kilogramme, or 7,700 per liter, and 90 deg. alcohol gives 5,100 and 4,200 calories respectively. A motor using alcohol should consume, in volume, about $7,700 \div 4,200 = 1.8$ times as much as gasoline for equal power. The petroleum motor demands at least 0.500 liter per effective horse power hour, and to obtain the same result 0.900 of alcohol (90 deg.) is needed. To sum up, as the price of alcohol per liter is somewhat more than that of gasoline, it would cost at least double to use it, and therefore the alcohol motor is not possible industrially. This is the conclusion of Messrs. Hospitalier, Ringelmann and others. The pan-alcoholists, such as Arachequesne, Petreano, etc., reply that this reasoning does not hold good, as practically a good alcohol motor does not consume 1.8 times more alcohol than gasoline, as is shown by the recent trials of automobiles. The question rests there at present, but it is time that it should be definitely resolved; the great number of documents recently obtained concerning the alcohol motor makes possible an explanation of the mystery which seems to surround it.

Taking up the reasoning, logical in principle, of the anti-alcoholists, we may compare the alcohol motor this time with the gas motor. As a petroleum motor is nothing more than a gas motor, its thermic efficiency should be about the same. A gas motor now easily gives an effective horse power hour with 500 liters of illuminating gas, or 2,000 liters of blast-furnace gas, representing a mean of 2,625 calories. As 90 deg. alcohol gives (as above) 4,200 calories per liter, there would be needed $2,625 \div 4,200 = 0.625$ liter of alcohol for the horse power hour. As gasoline requires 0.500 liter, the relation for an equal power is $0.625 \div 0.500 = 1.25$ instead of 1.8 as above. Let us analyze this result and see if it is plausible. The admitted consumption of 0.500 liter of gasoline per horse power hour is normal and regularly obtained by the motors of automobiles. The consumption of alcohol, 0.625 liter, has been already realized in the celebrated experiments made in Germany in 1897 upon a Korting motor of 6 horse power. This result has never been disputed since, and therefore seems as worthy of confidence as the others. This remarkable efficiency is explained by the adaptation of alcohol to an excellent fixed motor, utilizing the heat of the exhaust in a notable proportion. In automobile motors, less favorable, consumptions below 0.900 have already been observed. The results obtained by the Société des Agriculteurs with a Brillié motor should be noted (in the case of alcohol). Using three liquids, first gasoline, second carbureted alcohol at 50 per cent and third 90 deg. alcohol, the brake horse power developed was 7.32, 7.67, and 7.33 (or nearly the same), while the consumption per horse power hour was 0.677, 0.735 and 0.835 respectively. The data given by the automobile tests, while favorable for alcohol, cannot be used in this connection, as the conditions are not always the same. It should be noted that from the last set of figures we obtain $0.835 \div 0.677 = 1.23$ as the ratio of consumption of gasoline and alcohol. But how, then, do we explain the apparent anomaly between the results of comparing the alcohol motor to the petroleum motor on the one hand and to the gas motor on the other? The explanation, which is simple, is that the petroleum motor has in the actual conditions of practice a thermic efficiency inferior to the gas motor, as is admitted. The alcohol motor may, on the contrary, have, not the extraordinary efficiency claimed by some, but at least equal to that of the gas motor. To resume, if the petroleum motor may in theory claim a consumption below 0.500 liter and 1.8 times less than for alcohol (0.625 liter), it does not seem in practice to arrive as near its theoretical figure as alcohol, whence the relative advantage of the latter.

M. Chauveau thus reaches the following conclusion: First, in actual practice the gasoline motor cannot claim normally less than 0.500 liter per effective horse power hour, while the alcohol motor may approach 0.650. Second, the practical relation of the consumption of the two liquids may be reckoned at 1.33, or one third more for alcohol to obtain the same power. Third, with the price of 90 deg. alcohol (in France) at three-fourths that of gasoline, the cost per unit of power comes to about the same. Fourth, in the case where by a new method the petroleum motor is given the efficiency of the gas motor, or consumes 0.350 liter per horse power hour, the relation of consumption alcohol: gasoline will be 1.8.



BABY INCUBATORS AT THE PAN-AMERICAN EXPOSITION.

What is said to be the swiftest-timed short-distance train in Great Britain now is run upon the North-Eastern Railway, making an average speed of—from start to stop—60 miles per hour. The grades are very light, however, 1 in 5,700 and 1 in 2,400 feet, respectively, and the train weighs only 120 tons, while the engines are said to be very powerful; the drivers are 80 inches diameter. In a run of 26 miles the speed attained was at the rate of 73 miles per hour.

THE NEW RIVERSIDE VIADUCT, NEW YORK.

There has recently been completed one of the most important of the public works which are being carried out for the purpose of providing New York city with a complete system of suburban boulevards and driveways. The work in question is the massive viaduct which, for the past three years, has been under construction across Manhattan Valley. It has been built for the purpose of connecting Riverside Drive with the system of driveways which embraces the northerly end of Manhattan Island. Now that it is completed, there exists a continuous high-level boulevard from Seventy-second Street and Hudson River to the western end of Dykeman Street on the Harlem River, a distance of 7¼ miles. Dykeman Street forms practically a continuation of the Harlem Speedway; and as the latter is between two and three miles in length, the completion of the Riverside viaduct opens up to the people of New York a continuous drive of ten miles along the banks of the Hudson and Harlem Rivers. The new viaduct was built to carry the Riverside Drive at a high level across Manhattan Valley, which has here a width of about a third of a mile, and is intersected by six different streets. One of these forms the main approach to Fort Lee ferry, and is so greatly in use by electric trolley lines and general street traffic as to render the construction of a driveway northward across the valley at street grade very undesirable. By the construction of the viaduct, however, connection is made across the valley, free from the inconveniences of the cross-town traffic. Now that the work is completed, it may justly be said that the roadway from Seventy-second Street through Riverside Drive over Manhattan Valley and by way of Boulevard Lafayette affords one of the most picturesque and unique drives in any great city of the world.

Looking Northwest.

Looking Southwest.

THE RECENTLY COMPLETED RIVERSIDE VIADUCT, NEW YORK.

In designing the viaduct an effort was made to harmonize it in its general appearance with the surrounding country and more prominent local buildings. Its total length, including masonry approaches, is 2,074 feet; its southern approach is just below the historic villa Claremont, to the south of which towers the impressive pile of the Grant Memorial Tomb. The south masonry approach is 262 feet long, and the steel viaduct is 1,564 feet in length. The northern approach faces the Hudson River, the northern end of the viaduct being curved in as it meets the approach. The roadway, which is 60 feet in width, stands at an elevation of 75 feet above the street level. On each side of the roadway are 10-foot sidewalks supported on projecting brackets. The southern entrance, as shown in our engravings, is widened out and bounded by a semicircular wall, in the center of which stone staircases lead down to the valley below. The arches of the viaduct are of 65 feet span and are of latticed, plate-girder construction, rectangular in section. The supporting columns measure 3 x 5 feet in section and are also of latticed, plate-girder construction. The floor is carried on floorbeams, 5 feet in depth, of which there are six to each span, and upon these are laid thirteen 12-inch, I-beam, floor joists. Upon the joists is a solid floor formed of ⅝-inch buckle-plates, which are covered with a paving composition of coal-tar residuum and broken stone, over which is laid a smooth asphalt surface.

Manhattan Street is crossed by a large semi-circular arch of 130-foot span. It will be noticed that the plating of the columns is carried up, in every case, between the spandrels of the arches to the level of the under side of the longitudinal plate girders which carry the floor system. These plate girders are designed to bear the whole of the dead load of the floor system, and they have been so nicely calculated, that in the completed bridge their under side just touches the crown of the arches. Most of the live load that comes upon the bridge, consequently, will be transmitted directly to the arches, and transferred by them to the columns. In the case of the 130-foot span the two longitudinal plate girders were of massive proportions, being, indeed, two of the largest plate girders ever constructed. They are each 130 feet long, 10 feet deep, and 3 feet wide, and each weighs 62½ tons.

The work of raising these girders into position was accomplished by means of powerful derricks placed upon the completed structure to the south and upon a series of special trestle bents to the north of the crossing. Four hoisting engines were engaged in lifting each span, and the whole work was done with but a few hours' interruption to street traffic.

The Sanitary Arrangements of Stratford-on-Avon in the Time of Shakespeare.

It is not often that we are permitted to draw the veil so as to see the sanitary conditions of mediæval and early modern towns in their true light. In Sydney Lee's "Stratford-on-Avon" there is a chapter devoted to the santitary condition of that town in the time of Shakespeare, from which we glean the following interesting information. The clay floors, whether or not strewn with rushes, attracted all manner of refuse and were rarely swept. A well in the garden may have formed an adequate water supply; but the uses of water were not generally known. The mud walls between the gardens were not conducive to cleanliness. Very few of the ordinary laws of health were, in fact, observed by the householder; and the corporation made very frequent attempts to enforce such of them as, when neglected, created very obvious nuisance. Frequent penalties were imposed on those who failed to scour and clean the gutters and ditches before their residences. But the difficulty of disposing of household waste was very commonly met by "laying" in the streets and lanes, or in these ditches and gutters. John Shakespeare appears to have been fined on one or more occasions for making dirt heaps, and failing to keep his gutter clean. Six places in town were appointed for the massing of the filth in a legalized "muckhill." They were in almost all cases at the rural ends of the small streets; but as they were to be removed only twice a year, that is to say, before the feast of Pentecost and about Michaelmas, they were near enough to human habitations to make them a constant source of danger to health and life. Butchers, it is true, were forbidden to use them, and were ordered under a penalty of twenty shillings to take their refuse out of the town at nine o'clock each evening. The Town Council never supplemented the householder's neglect of cleanliness by any really adequate provisions. It delegated the duty of keeping the streets clean to the townfolk, and as they failed to perform this function the streets remained dirty. The Council only undertook the cleansing of the bridge, the market place and the place before the chapel door and guildhall; but in these days of the glorification of hygiene, there is a ludicrous ring about the details of the arrangements made for this object. For the sweeping of the market place in Shakespeare's day, a widow named Baker was employed at a yearly salary of six shillings and eight pence, and she was provided, at the municipal expense, with a shovel, a broomstick and twigs of trees. The duty of sweeping the bridge was intrusted to a man named Raven, who at times secured the additional service of the Widow Baker. The chapel was rarely defiled by water,

but on the occasion of the repair of its roof in 1604, Anthony Rees and his wife with Goodwife Wilson were directed to sweep away the cobwebs and wash the seats. Fresh rushes were occasionally laid in the Council Chamber and guildhall and the floor of the latter was renewed at intervals with clay. There was little pavement about the town. The market place, in fact, alone was paved, but the bridge and crossway were kept in fair order by a liberal sprinkling of gravel from the guild pits.

THE THREE GREAT SUSPENSION BRIDGES ACROSS THE EAST RIVER, NEW YORK.

The topography of New York city is such as to render the Rapid Transit problem more perplexing than that, probably, of any other city. The configuration of Manhattan Island, long and narrow as it is, and the concentration of business interests at the southern end of the island, cause a congestion of traffic on the north and south lines of travel which it is taxing the energies of the transportation companies, not so much to prevent (they can never hope to do that) as to mitigate and control. Every twenty-story business block that lifts its head "downtown," every "addition" that is laid out by the ubiquitous real estate speculator in the northern suburbs of the Bronx, means so much added to the flow of traffic, and a tightening of the strain upon the means of communication. Were the Hudson River and the East River impassable barriers between Manhattan Island, New Jersey and Long Island, the outlook for the future would, indeed, be very serious, and not even the splendid Rapid Transit System which is being built would avail to prevent, within a very few years, an absolute deadlock on the north and south lines on the island.

The problem of getting the citizens of New York into and out of Manhattan Island in the "rush" hours of business has been greatly assisted by the remarkable service of ferries across the two rivers, a service which has no equal anywhere in the world; and too much credit cannot be given to this feature of the general transportation system of New York. It was inevitable, however, that the question of bridging these rivers should ultimately be raised, and though a formidable difficulty was presented by the great width of the rivers, the Brooklyn Suspension Bridge, which now for nearly two decades has been rendering yeoman service between New York and Brooklyn, is an evidence of what bold and skillful engineering can accomplish, if only the means and money are forthcoming. The main span of the Brooklyn Bridge is 1,595 feet 6 inches, and each of the land spans from the center of the towers to the face of the anchorages is 930 feet, the total length of the bridge from anchorage to anchorage being 3,455 feet 6 inches. The Manhattan approach is 1,562 feet long and the Brooklyn approach is 971 feet. The total height of the under side of the bridge above mean high water is 133 feet. The total width of the bridge is 85 feet, which is sufficient to provide two tracks for a cable road, two tracks for trolley cars, two driveways, and an elevated footwalk for passengers. In 1894-5 work was commenced on another great suspension bridge known as the East River Bridge, which extends from near Broadway, Brooklyn, to Delancey Street, New York. The main span of this bridge has a clear length of 1,600 feet, and compared with its predecessor it is a much larger structure, the suspended roadway being 118 feet in width. It will provide for six elevated road and trolley tracks, and on the outside of each truss will be a roadway for vehicle traffic. There will be no terminal stations for this structure, as there are at the Brooklyn Bridge, the aim of the authorities being to provide a broad, continuous thoroughfare over which trains, vehicles and pedestrians may pass without any interruption. This bridge is situated about a mile and a half to the northeast of the present Brooklyn Bridge.

Our illustrations show a third East River Bridge, the plans for which have now been completed for some months, and the preliminary engineering work started, which is to cross the river from the foot of Washington Street, Brooklyn, to the foot of Pike's Slip, Manhattan. This, like the other two, will be a suspension bridge. It will have a total length between anchorages of 3,165 feet, and a span from center to center of towers of 1,465 feet. There will be four deep, riveted, double-decked trusses, on the lower floor of which will be four trolley roads, two within each truss; while on the upper deck of each truss will be a track for elevated trains. The total width of the bridge will be 120 feet, or 2 feet more than the new East River Bridge. The width of the carriageway between the trusses will be no less than 38 feet, and each sidewalk will be 11 feet in width. At the Manhattan end of the bridge there will be two loops of three tracks each, there being a loop for the tracks on each side of the roadway—a convenient arrangement which will get rid of the dangerous and troublesome crossing of the roadway by pedestrians, which is necessary at the Manhattan end of the present Brooklyn Bridge. The bridge will be carried on four steel cables, each pair of which will be connected with the floor beams of the structure immediately on the outside of the trusses, the suspension cables lying in close proximity to the trusses, as shown in our engraving. The new bridge has features in common both with the Brooklyn Bridge and the new East River Bridge. It will resemble the new East River Bridge in having steel towers, but will differ from it in the fact that the land spans are carried by suspension cables from the main cables—a feature in which it will resemble the older structure.

Another important bridge which is planned and upon which work is commencing is the cantilever structure that will cross the East River at Blackwell's Island.

Further means of transportation between New York and Brooklyn will be afforded by the Rapid Transit Tunnel, which will pass beneath the East River between the foot of Whitehall Street, Manhattan, and Joralemon Street, Brooklyn. The Rapid Transit Commissioners have lately decided that this tunnel shall be constructed. It will enable passengers to ride from any point on the Rapid Transit Subway in Manhattan Island direct to Brooklyn without change of cars. In our illustrations there is also indicated by dotted lines what is known as the Hudson River Tunnel, a scheme which, at present, is only partially completed, and is awaiting the necessary capital to enable it to be put through and equipped with the necessary appliances.

In our bird's eye view of the city, we have shown only those bridges and tunnels which are completed, or are under construction, or have received such authoritative sanction that construction is a matter of certainty. Hence the two proposed bridges across the Hudson River do not appear, for hitherto it has been impossible to obtain the enormous capital which would be necessary to put through even one, to say nothing of two, of these much-needed but long-delayed engineering works. At the same time it should be mentioned that during the past few weeks the question of a crossing of the Hudson River at Twenty-third Street has been revived, and that the Pennsylvania Railroad is apparently interested in the scheme. Should the railroad systems that terminate in New Jersey take hold of the enterprise there will be every probability of its being started and carried vigorously to completion.

Laughter and Long Life.

It may be that some enthusiastic and laborious German statistician has already accumulated figures bearing upon the question of length of life and its relation to the enjoyment thereof; if so, we are unacquainted with his results and yet have a very decided notion that people who enjoy life, cheerful people, are also those to whom longest life is given. Commonplace though this sounds, there is no truth more commonly ignored in actual every-day existence. "Oh, yes, of course, worry shortens life and the contented people live to be old," we are all ready to say, and yet how many people recognize the duty of cheerfulness? Most persons will declare that if a man is not naturally cheerful he cannot make himself so. Yet this is far from being the case, and there is many a man who is at present a weary burden to his relatives, miserable through the carking care of some bodily ailment, perhaps, or some worldly misfortune, who, if he had grown up into the idea that to be cheerful under all circumstances was one of the first duties of life, might still see a pleasant enough world around him. Thackeray truly remarked that the world is for each of us much as we show ourselves to the world. If we face it with a cheery acceptance we find the world fairly full of cheerful people glad to see us. If we snarl at it and abuse it we may be sure of abuse in return. The discontented worries of a morose person may very likely shorten his days, and the general justice of nature's arrangement provides that his early departure should entail no long regrets. On the other hand, a man who can laugh keeps his health and his friends are glad to keep him. To the perfectly healthy laughter comes often. Too commonly, though, as childhood is left behind the habit fails, and a half-smile is the best that visits the thought-lined mouth of a modern man or woman. People become more and more burdened with the accumulations of knowledge and with the weighing responsibilities of life, but they should still spare time to laugh. Let them never forget, moreover, and let it be a medical man's practice to remind them that "a smile sits ever serene upon the face of Wisdom."—London Lancet.

There have been no indications of any attempt to use the great Paris telescope seriously for astronomical work. Some photographs of the moon have been taken, but they are said to be inferior. In fact, the telescope is a great disappointment to scientific men; although it was the largest in the world, it has been of no use, and it has evoked a most caustic article in The London Saturday Review.

Correspondence.

Straw as Fuel.

To the Editor of the Scientific American:

Noting the numberless straw stacks standing in the fields in the wheat country, having practically no commercial value, thousands of tons being burned in order to rid the fields for resowing, it seems to me there is need of some machine and process of converting this straw into fuel suitable for cooking and heating purposes. Such machines should be capable of moving about from place to place, as does a thresher, and should do the work cheaply.

It is my belief such a machine would be of great mutual benefit to both farmer and inventor.

Newkirk, O. T., July 18, 1901. N. E. Spencer.

Ice Manufacture in India.

To the Editor of the Scientific American:

Twenty-six years ago, when I first went out to India, if one wanted to enjoy the luxury of ice, residence must needs be in one of the great cities—Calcutta, Madras, or Bombay. It was all brought from the United States, and the old Tudor Ice Company practically controlled the trade. The standard price was two annas for a *seror*, or six cents for two pounds.

In all other sections of the country the people were obliged to cool their drinks with a freezing mixture composed of saltpeter and sal ammoniac. During the hot winds it was the custom to put water bottles in wet straw, and then, by the use of baskets, the carriers could swing them until they were cool. The same practice still obtains in the up-country, and by it the water can be cooled down to 65 degrees Fahr. By using the salts and furnishing continuous fresh supplies, water can even be frozen, but the expense is large and the labor tedious.

After a while science came to our aid. The Scientific American gave details of the sulphuric ether and ammonia machines, and later—in the sixties—of the wonderful Carré machines. Indian enterprise was not slow to copy and import, and "ice in two minutes at a temperature of one hundred" was the cry. But it was expensive. Indian ingenuity saw its opportunity, and grasped it. The system came into vogue somewhat slowly, but it was accentuated from the first, and is in quite large favor. The process depends almost altogether on the production of cold by evaporation, and on the prevalence of the west wind. Ice cannot be made in India when the east winds blow. The essentials for the production are exposed and treeless fields, laid off in squares of four or five feet, and the ground covered several inches deep with coarse straw; numerous flat porous earthen plates, about nine inches in diameter; an unlimited supply of water; an army of coolies and water carriers; and the ice-pit. The last-named is the most important adjunct to the process of manufacture, and is carefully made. It consists of a deep pit, in which is built a huge timber cone, the space between it and the walls of the pit being rammed with charcoal, chaff, and chopped hay. The cone itself is lined with felt blankets and mattings. Over the entire pit is constructed a straw hut, with very thick walls and roof, and a small entrance.

One other thing is also noticeable on the spot, and should be mentioned, and that is a mammoth drum, which is kept standing close to the entrance of the hut.

Weeks may pass without any "cool west wind," and every night, all through those days or weeks, watchmen are on duty, much the same as if an enemy were expected. They are made to understand that it is a question of duty, and they are to watch unceasingly. Sooner or later, at dead of night—one, two, or three in the morning—the breeze is felt. It is rarely felt before midnight. As soon as the watch is certain the great drum is beaten, with both fists and elbows, and the coolies assemble by hundreds. Water is poured into the saucers, and as the evaporation ensues, the coolies dexterously turn the plates, sift in the salts, watch the congelation, and at once on its occurrence run to the pit with the ice. There it is emptied, pounded into a mass, and consolidated by regelation. In many pits thousands of pounds weight is pitted.

It is interesting, and somewhat curious, to talk with these ice-makers. Asked as to the *rationale* of the process, they glibly reply that the cooling is so rapid that the slow influx of air is overbalanced. The ice produced is, of course, very much like "anchor ice," and when it is taken from the pits for use it is removed by nine-pronged hoe-forks.

Westfield, N. J. Giffard Knox.

By the will of the late Jacob H. Rogers, the locomotive builder, the bulk of his fortune, possibly eight million dollars, is left to the Metropolitan Museum of Art, New York, as an endowment fund, the income to be used for the purchase of objects of art. This will place the Museum on a splendid footing.

Automobile News.

A service of steam motor wagons is now running between London and Tunbridge Wells.

It is said that the cartage bill of Boston in the course of a year is not less than ten million dollars. This shows there is an enormous field for automobiles.

Motor carriages in France are to be taxed according to their power. They put a tax of $1 per horse power in addition to the ordinary tax of four-wheeled carriages.

Arrangements are now being perfected for the automobile road test between New York and Buffalo, which will commence on September 9. The average stages will be from 88 to 90 miles in length. The total distance to Buffalo is 500 miles. Great care is being taken so that the route will include all conditions of roads likely to be met with in a general tour of the State. The regulations are now being framed.

The following prizes were bestowed on the occasion of the Paris-Berlin race: M. Fournier received the prizes given by the German Emperor, the King of the Belgians, the Grand Duke of Luxemburg, and the city of Hanover. Herr Werner received a prize given by President Loubet; M. Giraud the prize given by the Grand Duke of Mecklenburg, and M. Renault the prize given by M. Millerand, the French Minister of Commerce.

In future races the Automobile Club of France will require that cars, when fully equipped, shall weigh only about two thousand pounds. Modern racing cars weigh a ton and a half and over. The policy of builders of racing cars has been encouraged by the absence of any weight limit in races. If the new regulations are enforced, it may result in a revolution in automobile-building, but a worthy revolution, as the latest types of racing cars have been fully developed enough for all practical purposes.

Mr. S. F. Edge, who was the only English competitor in the Paris-Berlin motor race, experienced a curious accident which rendered him *hors de combat*. He was driving a 70 horse power Napier car. The vehicle traveled splendidly, and prior to his first puncture he drew up from twenty-fifth position, at which he started, to ninth in the first 50 miles. His tires then punctured no less than seven times. The final accident that caused his retirement was while passing another competitor. He could not see his way, owing to an enormous cloud of dust, and while traveling at about 70 miles an hour he struck the arched curve of the road over a small bridge. The car leapt into the air and bounced down upon the ground again like an India rubber ball with terrific force. The back carriage spring broke under the impact, and as its replacement would have occupied two days, Mr. Edge withdrew from the race.

New Element: Europium.

BY OUR PARIS CORRESPONDENT.

M. Demarçay, in the course of his spectrum analysis work, claims to have discovered a new element, to which he proposes to give the name of *europium*. In the account which he has lately presented to the Académie des Sciences, M. Demarçay brings out the following points. Sir Wm. Crookes, while pursuing his vacuum tube researches, observed in 1885 a band which he attributed to samarium and which on account of its disappearance in the presence of lime, and other peculiarities, he called the *anomalous ray*. Later on he distinguished it, together with a great number of other bands, each of which appeared to characterize a special meta-element. He called S δ the hypothetical meta-element which corresponded to the *anomalous ray*. In 1892 De Boisbaudran described a series of three brilliant blue lines, which he discovered in the spectrum of the samarium spark. These lines could be brought out more strongly by a fractional treatment of the material and he concluded that they were due to a special element, which he called Z ζ. In 1896 M. Demarçay announced the presence of an element intermediate between gadolinium and samarium, which was characterized by several strong violet and ultra-violet rays. He also showed that the new element was identical with that of De Boisbaudran, and no doubt accounted for the anomalous band of Crookes, as well as other rays not yet described. At that period M. Demarçay could not obtain enough of the material to make further experiments, but at present he has accumulated a larger quantity of it by a fractional treatment of nitrate of magnesium, and finds that its characteristics, namely, line and absorption spectra, electric fluorescence of the sulphate in vacuo, etc., accompany it constantly and are proportional, thus evidently belonging to one and the same element. The purity of the few grammes of the new oxide obtained was sufficiently great to exclude all the samarium rays, and only the stronger gadolinium rays were visible in the electric spectrum. If the product was added in traces to sulphate of calcium, it gave a brilliant spectrum of fluorescence in which the *anomalous ray* predominated. This spectrum includes three principal bands, $\lambda = 609$, very strong; $\lambda = 576$, considerable and wide; $\lambda = 593$, strong and very wide (the figures are approximate). The degree of calcination of the sulphate caused variations in the bands; the strongest seems to change to a double ray when the calcination is strong. The author proposes the name *europium* for the new element, with the symbol eu = 151 (about). He then gives a list of forty of the principal rays of its spectrum comprised between $\lambda = 500$ and $\lambda = 350$; the strongest of these are as follows: $\lambda = 4{,}662.6$; 4,627.8; 4,594.5; 4,435.8; 4,205.4; 4,130.0; 3,972.0; 3,930.7; 3,819.5, etc.

In this spectrum the samarium rays were entirely absent and the strongest gadolinium rays were scarcely visible. Besides the rays given, which no doubt belong to *europium*, a great number of feeble rays are seen, which may belong to this element or perhaps to an unknown element even more rare; this the author proposes to study later.

A NEW KIND OF WATER-TANK.

To provide a construction which will prevent leakage and bruising and warping of the wood of water-tanks and which will keep the water in the tank cool and clean is the purpose of an invention patented by Dr. Edwin F. Evans, of Fredericksburg, Tex.

The tank has an outer wall and an inner wall spaced apart to form an annular chamber, into which a water-inlet extends. Apertured segmental rings serve to space the outer wall from the inner wall and are received in grooves in the opposing faces of the walls. As shown in our illustration the tank is provided with four such segmental rings at different levels.

At the bottom of the chamber a series of vertical segmental blocks are located, which are chamfered at their lower periphery. Vertical perforations in these

A WATER-JACKETED TANK.

blocks place the bottom chamber thus formed in communication with the chamber formed by the side walls. Bolts provided with washers hold the blocks in place. An outlet cock allows water to be drawn from the chamber between the side walls.

Water flowing into the chamber between the side walls rises in the chamber and finally flows over the inner wall and into the tank. The inner and outer walls will, therefore, always be kept moist, so that leakage, shrinkage, and moving of the hoops is avoided. The main body of water is protected and kept cool by the outer jacket of water. The water in the chamfered blocks on the bottom of the tank keeps the bottom joint in good condition.

Owing to the widespread popularity with which the Central London Electric Railway is regarded, and in order to cope with the exigencies of the passenger traffic, the railroad authorities propose to carry out several improvements which will enable them to run their trains at faster intervals than is possible at present. The service now is a train every 2¾ minutes. The service, under existing conditions, cannot be accelerated, owing to the time that is lost in shunting the trains at either end of the railroad. The latest proposition to overcome this difficulty is to construct a large loop at each terminus, so that the trains will simply run round from the up platform to the down platform. At the city end the loop will be a large one, so that a station may be provided at Liverpool Street, one of the busiest trunk railroad termini in the city. By this means the service will be accelerated to a train every minute and a half. It is also proposed to try some geared motors with a view to overcoming the vibration, over which such an outcry has been raised. It is thus anticipated that the locomotives, being fitted with springs, will break the force of the impact upon the rails and the earth, and also insure comparative silence in running.

Engineering Notes.

Gas is about to be made in Canada from peat fuel.

In some trials of steam pumps in England recently the efficiency is asserted to have been from 95 to 99.8 per cent, the pump cylinder being taken as full in the estimate.

At the Germania yards at Kiel, one of the establishments of the Krupps, hereafter all ships will be constructed in large covered slips. The idea of building ships under cover is not new, having been practised in England for a long time.

A Chicago boy recently went around the world in competition with a boy from New York and one from San Francisco to see which one could make the journey around the world in record time. As was almost to be expected, the wideawake young man from the Middle West, whose name is Charles Cecil Fitzmorris, was the winner. He made the globe-encircling journey in sixty days, thirteen hours, twenty-nine minutes and forty-two and four-fifths seconds, thus beating the best previous record by many days.

A set of triple expansion engines of 1,400 horse power recently erected in an English electric lighting station have shown remarkable results as regards economy, the weight of steam used per horse power per hour being but little over 10 pounds. Steam at 200 pounds per square inch is used and superheated 100 degrees Fahr.; the valve gear is of the Corliss type, and no variation in speed over two per cent is allowed; from full load to no load speed must not exceed five per cent variation. This last is not very difficult of attainment, many American engines running much closer than these limits.

The influence of improved appliances in marine engineering has been very marked in the past fifty years, for where in 1854 it required 7.69 men per 100 tons of shipping, in 1900 it required less than 3½ men. The economy resulting from inventions follows in all lines of operation, particularly in fuel, which has fallen from 5 pounds of coal per horse power per hour to under 1½ pounds, with a corresponding increase in the speed, so that, with the reduction in space required for coal, much more cargo can be carried. Where it cost nearly four cents to carry a ton of grain one mile on sea, it can now be delivered for about one-fiftieth part of that sum.

Owing to the remarkable increase in the importation of petroleum into Europe, via Antwerp, extensive alterations are contemplated at that port in order to cope with the exigencies of the augmented traffic. It is intended to construct a series of new docks equivalent in length to 2,000 yards, together with necessary wharves and buildings. This increased accommodation is to be situated to the south of the city, and as sufficient dwellings are to be erected there to house the employes working at the new docks, the nucleus of another town will thus be formed. It is anticipated that Antwerp will then become the general depot for petroleum for the whole of Europe. The fulfilment of the scheme will involve the expenditure of several million dollars, and this is to be voted annually in installments by the Municipal Council.

The water-tube versus fire-tube boiler for vessels of war still occupies a great deal of attention abroad, and two vessels in the English navy, the "Hyacinth" and the "Minerva," have been, and are being, tested to settle certain moot points; the experiments can, at the best, prove conclusive only as to the particular voyage undertaken, the action of the two types for long periods and under all conditions being the only verdict of practical value. It is undeniable that both types have special features of merit, and it remains to be shown what can be dispensed with and what is essential. Economy in the use of fuel is perhaps the least consideration as compared with immediate availability in steaming at full power, and reliability as concerns continuous action; no one type possesses all of these features, and long experience of all the service required is needed in selection of boilers for certain classes of vessels.

During the progress of the construction of the reservoirs for the enlargement of the London water supply, a splendid specimen of an ancient ship has been discovered in the bed of the old River Lea, the course of which has been diverted in order to permit the excavations. The vessel was found at a depth of seven feet below the surface. It is about 50 feet long and is constructed of oak throughout, with the exception of the keel, which is of elm. The ribs of the boat are secured to the sides by trenails, while the timbers are secured with crude and primitive, though well-made iron nails. The floorboards are also fastened together with nails and the calking is done with felt. Many antiquarians, who have examined the relic, think that it constituted a part of the fleet with which King Alfred the Great fought against the Danes. Another curious dugout boat, estimated to be about 2,500 years old, was also unearthed and is to be deposited in the British Museum.

A WAVE MOTOR.

BY CHARLES F. HOLDER.

If the experiments which have been made to control the actions of waves and to render this power available to man were to be collected in book form the result would be a large volume. Nearly all such efforts have been unsuccessful, but this has not deterred inventors, who are continually at work endeavoring to solve the problem. At least one attempt has met with success. Mr. Hancock Banning, one of the proprietors of the Wilmington Transportation Company, with Mr. Frank Carey, has been for some time experimenting with a simple contrivance, which, by the aid of wave power, has successfully pumped water and rung a bell. The invention is to be permanently established at the harbor of Avalon to ring a bell as a fog alarm and to pump salt water into a large reservoir from which the streets of the town are watered. The machine is also to be used in pumping out ships.

The inventors originally were searching for power to ring a bell, but when the machine was completed it was found that there was more value in the pumping capacity. The photographs shown illustrate both phases of the motor. The machine is shown rigged for both purposes. It is a large iron cheese-box shaped vessel about two feet in diameter, and is intended to be riveted to the deck of a ship, or to a floating platform. The pedestals contain pistons which are connected by levers with metal buffers on the inside, which surround a saucer-like platform, shown in the sectional view. The latter is supported by a pivot. On this rests a ball weighing one hundred and fifty pounds, also shown in the photograph. Experiment has demonstrated that the slightest movement of the water, wave or ripple, is sufficient to move the ball and make it oscillate, and every move it makes one or more of the "buffers," or all of them, are pushed down in succession, thus working the levers and raising the pistons, and so operating the pump. No matter what the conditions, two of the pistons are always up and two down. Experiments have shown that with even a moderate motion, or quiet sea, the number of strokes ranged from eighteen to thirty-two a minute, and the power generated was one-tenth of a horse power, showing thereby that larger motors, which are equally practicable, will provide all power necessary for the purposes named. Mr. Banning is having a larger motor built on the same lines, which is to be used for various purposes in the town of Avalon.

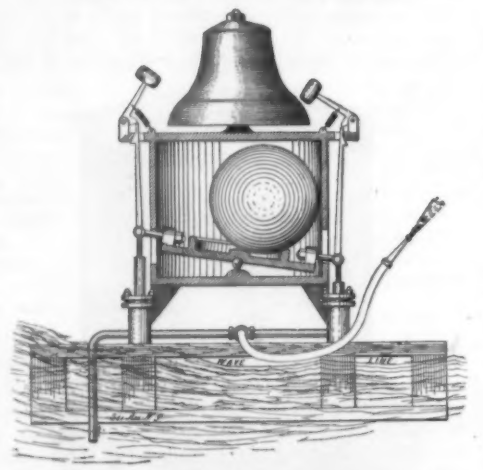
This motor has been tried as a bell buoy with success. Mr. Banning says: "We claim that this motor will ring a bell under very slight wave motion at times when the sea is so smooth that the bell buoy now in use cannot be operated. Experiments in Avalon Bay on a calm day have proven the above claim."

The cost of construction is small and the endurance of the machine is very considerable. At the practical test made in the calm waters of Avalon Bay the motor rang the bell sixteen times per minute, and in a rough sea this would be increased to forty times. The coast of southern California, though abounding in fogs, is singularly unprotected. At San Pedro there is no whistling buoy; yet the port is crowded with vessels, and steamers often are obliged to feel their way in. The islands of southern California have neither lights nor buoys of any kind, and it is hoped that the bell buoy above described will prove a cheap device well suited to the locality.

Observation of Ball Lightning.

M. J. Violle gives an account of a globular lightning discharge which he observed near the west coast of France. On the 9th of June, at 1:30 P. M., toward the end of a rather heavy storm passing above Fixin, near Gevrey-Chambertin, the author observed the ball lightning under the following conditions. He stood in a balcony facing the east, and from there watched the storm, which took the form of lightning discharges, succeeding each other at somewhat close intervals, under the form of fiery lines slightly sinuous in character and nearly vertical. He estimates the distance at about two miles. Then, after the strokes had ceased for a few minutes, he saw a ball of fire which appeared to drop from the heavens like a stone, and in the same place where the rectilinear lightning had occurred; also at about the same height. After an interval the region continued to be illuminated several times by lightning under the form of diffused discharges confined to a limited space. The phenomenon cannot be attributed to an optical illusion, as another person, standing beside the author, observed the same effect. M. Violle assured himself that there had been no fall of an aerolite at that time. The appearance of the phenomenon, besides, left no doubt as to its electrical nature.

WAVE MOTOR WITH COVER REMOVED.



SECTION THROUGH MOTOR, SHOWING PUMPING AND BELL-STRIKING MECHANISM.

THE LARGEST FLOATING DOCK IN THE WORLD.

BY OUR ENGLISH CORRESPONDENT.

Messrs. Robert Stephenson & Company, Limited, the well-known shipbuilders of Hebburn-on-Tyne, England, have recently completed the construction of a self-docking pontoon dock for the Spanish government, which is the largest floating dock in the world. The contract for the dock was placed prior to the American war, and it was originally intended for the port of Olongapo, the former Spanish naval arsenal in the Philippine Islands, for docking ships of the Spanish navy. When the war broke out the work of construction was necessarily interrupted. After the cessation of hostilities, and the annexation of the Philippine Islands by this country, another destination had to be selected for the accommodation of the dock, and it was finally decided to place it in the port of Mahon, in the island of Minorca.

The dock is of very fine workmanship, and of extremely strong construction, in order to comply with the requirements of the Spanish Admiralty, which are that if a ship of 12,000 tons weight, with a length of 328 feet, be placed in the center of the dock, no part of the structure shall be worked to more than 6.33 tons per square inch in extension, and 7.6 tons per square inch in compression.

The principal dimensions of the dock are as follows:

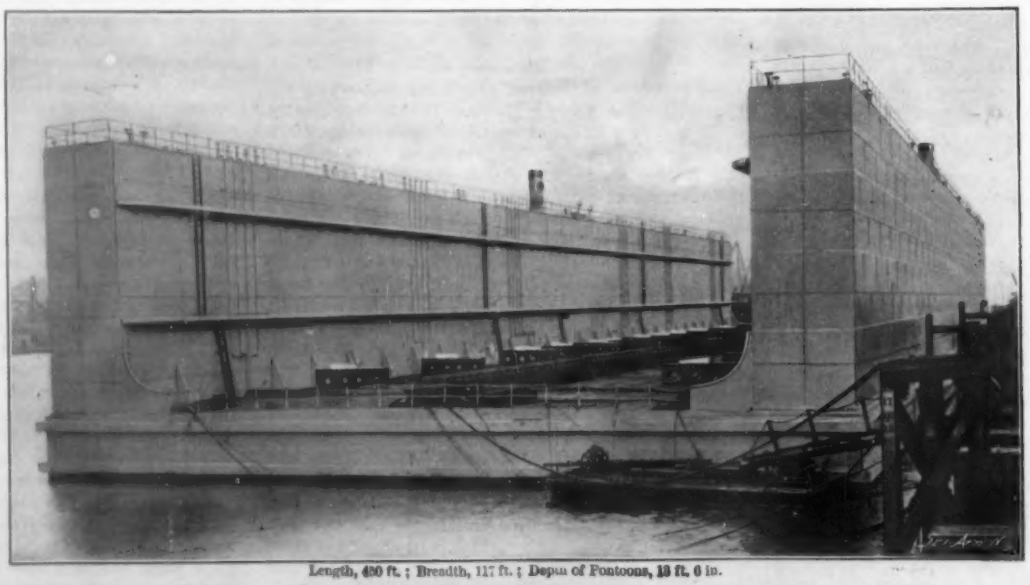
Length between perpendiculars	450 feet.	
Breadth, molded, over pontoons	117 "	
Depth, molded, of pontoons	18 "	6 inches.
Camber of pontoon deck between side girders		9 "
Breadth, molded, of side girders	12 "	2 "
Depth, molded, of side girders above pontoons	38 "	6 "
Distance over side girders, molded	115 "	4 "
Distance between side girders, molded	91 "	
Distance between shoring platforms	85 "	
Distance between pontoons, molded	1 "	
Maximum lifting capacity ..... ship weighing 13,000 tons.		

The bottom portion of the dock is built of iron, and is composed of six pontoons, each measuring 74 feet 2 inches in length, by 117 feet in width, and 13 feet 6 inches molded depth. On the top of these are placed the six towers or girders securely bolted to the pontoons and binding them all together. The pontoons are also connected together by junction plates, extending across the dock at each pontoon end. The side girders are built of steel on account of their having to take the strain when a ship is docked; also, since they are so much out of the water, they are not so liable to corrosion. The pontoons are very strongly constructed, having eleven fore-and-aft bulkheads, nine of which are water-tight, dividing each pontoon into ten water-tight compartments. This makes for the six pontoons an aggregate of sixty water-tight compartments in the bottom of the dock, all of which are tested with a water pressure of 13 pounds per square inch.

Every fifth frame in the pontoons is a strong partial bulkhead, extending across the dock, and over these frames the bilge blocks are placed. The center girder over which the keel blocks are laid is one inch thick, and under the keel blocks, 4 feet from the center on each side, there are two more fore-and-aft bulkheads. These, with diaphragm plates on every frame, make a very solid foundation under the keel blocks. The side towers have a safety deck about 14 feet above the pontoons, which prevents the dock sinking altogether, supposing the inlet valves were by any chance left open. Each tower is also divided into ten water-tight compartments.

The center compartment of each tower is fitted with the pumping installation, comprising two large marine type boilers, working at 120 pounds pressure per square inch; two of Tangyes' 24-inch centrifugal pumps, each driven by a separate engine; one duplex drainage pump and fire pump; two duplex feed donkey pumps, and a feed heater. Together the four main centrifugal pumps are capable of throwing 23,000 tons of water against a 28-foot head in two hours.

The 26-inch main suction pipes and the main drainage pipes run alongside the side towers and branch down at each pontoon to a collecting box, from which pipes lead to each compartment of the pontoons. Each of these pipes has a separate valve worked by a rod and wheel from the top of the side towers. Each compartment has also a wrought iron air pipe which is led up the side towers and placed near the standard and wheel, which operates the valve to the corresponding compartment. At the top of the air pipe is placed a gun metal cock. The inlet pipes, which are 19 inches in diameter, are also connected to the collecting or distributing boxes, and each inlet pipe has a grid and valve worked from the top of the towers. Every water valve in the dock has an indicating plate and pointer showing how much the valve is open. Each pump, by means of valves, is arranged to suck from one or both ends of the dock, and each pump has a 24-inch valve on the discharge branch, and also a balanced flap valve. The drainage pump is ar-



Length, 450 ft.; Breadth, 117 ft.; Depth of Pontoons, 13 ft. 6 in.

SELF-DOCKING PONTOON DOCK FOR THE SPANISH GOVERNMENT.—(Largest Floating Dock Yet Constructed.)

ranged to pump from each compartment through a separate range of pipes, and there is a gun-metal drainage foot valve at the bottom of each branch pipe to each compartment of each pontoon. The drainage pump is also connected to a range of pipes which are carried along the top of the side towers for washing decks, or for fire purposes. The compartments in the side towers are filled and drained through the main suction pipes, and they can also be drained into the pontoons by means of scupper valves worked from the decks of the pontoon. There are speaking tubes from each tower to the engine rooms, and also from side to side.

The keel blocks, which are placed 3-foot centers, are of pitch pine, and are 3 feet 6 inches high. The lower blocks are 18 inches square, and each keel block has a cap piece of oak 6 inches thick. The blocks are fitted between angle irons and are securely dogged together. There are twenty-four bilge blocks of very strong construction, placed on the dock, so that they can be shifted in or out, and on the top of each steel bilge block is a sliding block of oak which is pulled into position under water by means of ropes led to the top of the towers.

There are two shoring shelves inside the dock on each side, 2 feet 6 inches wide, with a facing piece of elm 9 inches by 6 inches. The sides and ends of the dock are protected by two American elm fenders securely bolted between angles. On the tower tops are placed fourteen large timber heads for mooring ships using the dock, and four mooring shackles are attached to the pontoon for mooring purposes. Wrought iron ladders lead up from the pontoons to the shoring shelves and tops of towers.

On the inner side of the towers in the stokehold water-tight doors are placed giving access to the deck of pontoon and for discharging ashes. The engine room and stokeholds are ventilated by cowl ventilators and a range of ventilating pipes. Feed tanks are placed on each side above the boilers, each holding 25 tons of fresh water for feed purposes. There are also bunkers which will hold 30 tons of coal in all.

The dock has been so constructed that in the event of damage to a pontoon, or if a pontoon requires bottom to be scraped and painted, it can be detached and docked on the dock itself to be overhauled. This is accomplished by disconnecting the bolts that hold the pontoon to the side girders and to the pontoons adjoining, severing the suction pipes and valve rods and letting water through the sea valve into the pontoon when it is detached. This causes it to sink below the level of the bottom of the side girders, and it can be easily drawn out at either side. It is then turned round so that the narrow part faces the entrance of the dock. The latter is then sunk sufficiently to let the pontoon float over it. The water is then pumped out and the pontoon raised. When the necessary repairs are completed the process is reversed and the pontoon brought back into place and rebolted to the side girders.

The dock was towed down the Tyne by seven tugs. When it reached the mouth of the river it was taken in tow by three powerful tugs belonging to Messrs. Smit & Co., of Rotterdam, who make a specialty of long-distance towing of this description. Two tugs towed the dock with tow ropes of 20-inch manila, and the other tug steered with a check rope of 13-inch manila. The towing journey from the Tyne to Port Mahon, a distance of two thousand one hundred miles, occupied approximately thirty days.

A lightship has recently been launched in Scotland which is unique in many respects, not the least one being that the vessel will carry no crew. What is known as the "compound gas system" provides for the lights for several months at a time, the gas being carried in a large tank and pipes therefrom being led up a hollow mast to the lantern, 25 feet above deck; communication is doubtless made with the shore to extinguish the light during the day. A large fog-bell is also provided which is rung by the roll of the vessel, and also by the passage of the gas to the lantern when there is not sea enough to toll the bell.

SOME REMARKABLE TREE GROWTHS.

Our engravings represent two remarkable examples of tree growth. The first is a famous yew tree near Kü Chou in southeastern Shantung, China. It is a fine specimen of the *Salisburiana adiantrafolia* and is of so large a size that there is space at the head of trunk, where the branches begin to spread, for eight men to take a meal around a square table. Tradition places the age of the tree at three or four thousand years, and Confucius is said to have rested in its shade. The species is of such slow growth that the Chinese have a saying to the effect that you need not plant the Pei Kwo, as they call it, if you have no grandson. The name "maiden's hair tree" is given to it on account of the shape of the leaf. It is also called a yew on account of its botanical relationship. Our photograph was taken by the Rev. W. O. Elterich and was contributed by W. Reid Faries, of Shanghai.

YEW TREE IN SOUTHERN SHANTUNG REPUTED TO BE 3,000 OR 4,000 YEARS OLD.

CURIOUS GROWTH OF A LINDEN TREE, MAHWAH, N. J.

Our other engraving shows the abnormal development of a linden tree (*Tilia americana L.*) which is also known as basswood, lime-tree or bee-tree. It stands on the Havemeyer farm, which is known as the Hillside Farm, Mahwah, in the northern part of New Jersey. The tree is about 120 years old, 30 feet high, and, including both sections, is 30 feet wide. It stands on the Ramapo River in a wet, swampy place. It is one of the most remarkable botanical curiosities in this part of the country. The twin branches really appear to be horizontal trunks. The photograph was made by A. Denninger, and it was contributed by the Rev. Dr. Kimber, of the chapel of St. Augustine, New York city. The linden tree attains a great age. At Neustadt, Germany, there is a linden tree which measures 399 feet in circumference. The most ancient linden perhaps in all Europe is the Donndorf, near Bayreuth. On a map dated 1390 it is mentioned as a very old linden, 24 yards in circumference. The age is given as more than twelve centuries.

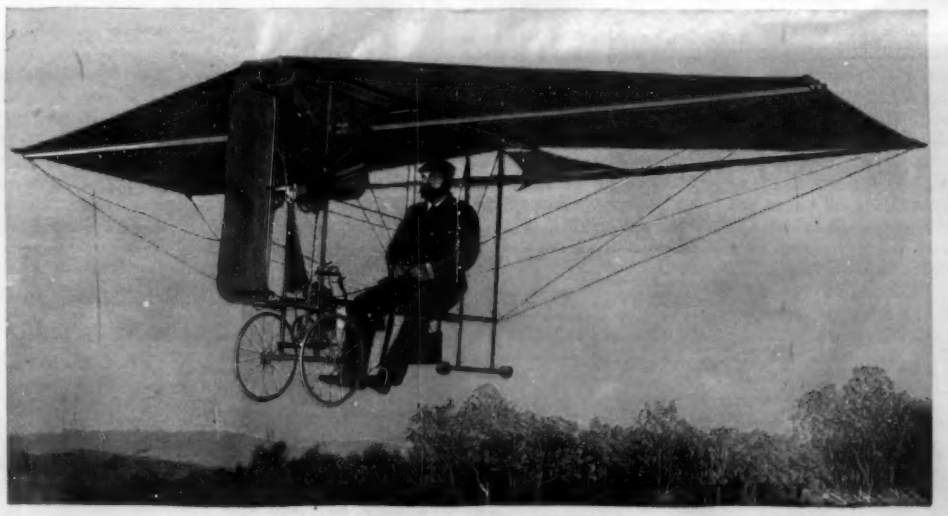
NEMETHY'S FLYING-MACHINE.

Undeterred by the failure of the German engineer, Hofmann, a Hungarian manufacturer, Emil Némethy, has constructed an aeroplane which differs in no essential from the contrivance of his predecessor, but which he believes will meet with considerably more success. Némethy's interest in flying-machines is merely that of a sportsman. Aerial navigation, he argues, can become a sport only if the cost of a flying-machine can be reduced to that of an automobile. His aeroplane is therefore built on a rather small scale. But despite its size, the inventor trusts that his machine will glide through the air as easily as in the somewhat fanciful picture which we reproduce from the Illustrirte Zeitung.

Némethy's machine is an aeroplane weighing only 66 pounds. Originally a motor of three-quarters horse power, weighing 25 pounds, was mounted on the frame of the contrivance for the purpose of driving the single propeller; but the inventor has decided that three-fourths of a horse power are inadequate and has recently fitted the machine with a 2¼ horse power gasoline motor. The current of air driven by the propeller under the wings or air-resisting surfaces will, it is thought, be sufficient to sustain the machine in the air. In order to overcome the inertia of the aeroplane, Némethy will construct a rather steep ramp terminating in a short upwardly inclined path. The machine, according to Némethy, will dash down the ramp at a high speed, then up the short incline, the momentum acquired, supplemented by the power of the rapidly rotating propeller, serving to drive the aeroplane onward in the air.

The saddle for the aeronaut is so connected by wires with the front and rear ends of the machine that, it is claimed, the center of gravity can be shifted longitudinally or laterally in order to change the direction of flight. Némethy believes that, with his machine, the aeronaut will, with a certain bird-like instinct, incline his body to shift the center of gravity in times of emergency.

The wings have an area of 194 square feet. With the new motor the aeroplane will weigh 154 pounds. Hence each square foot of the wings must sustain nearly four-fifths of a pound—a ratio between supporting surface and weight which is said to exist in the case of many birds. The relation of the total weight (300 pounds, including the aeronaut) to the motive power is unfavorable. Némethy has patterned the wings of his aeroplane after those of a swallow.



NEMETHY'S FLYING-MACHINE.

MILK PRESERVATIVES.—M. Wynter Blyth detects the presence of added preservatives in milk by the following simple process. To 10 C.c. of each sample of milk to be tested, and to 10 C.c. of sterilized milk known to be free from preservative, 2 C.c. of very strong solution of alkaline litmus is added. All the tubes are then examined, and if not of the same shade of blue as the control tube, semi-normal NaHO solution is added to them until the tint is identical. All are then plugged with cotton wool and heated in the water bath to 80 deg. C. for ten minutes. After cooling, each tube, including the control tube, is inoculated with 0.5 C.c. of a mixture of sour milk in water (1 C.c. of milk in 200 C.c. of water). They are then allowed to stand at ordinary temperature for twenty-four

hours. If the control tube be not then white, or nearly so, the series should be allowed to stand longer. The tubes of milk containing added preservative will then be found to be blue or pink, while those which are pure will be white, like the control tube.—Analyst.

The Color of Skylight.

Dr. N. E. Dorsey treats on the color of polarization of blue skylight in an article in the Monthly Weather Review. The subject has been considered of great interest for hundreds of years. Leonardo da Vinci considered that the blue of the skylight is due to the mixing of the white sunlight reflected from the upper layers of the air, with the intense blackness of space. Sir Isaac Newton thought that the reflecting particles were small drops of water. This theory was at first generally accepted, but in 1847 Clausius subjected it to a strict mathematical analysis. He proved that the light of the sky cannot be due to the reflection of sunlight in small drops of water. Tyndall, in 1869, demonstrated that when the particles causing the turbidity are exceedingly fine, scattered light is not only a magnificent blue, but is polarized in the plane of scattering; the amount of polarization is a maximum at an angle of ninety degrees with the incident light, and the definition seen through it is unimpaired by the turbidity. Lord Rayleigh undertook the analytical treatment of the subject, and proved quite recently that about a third of the total light from the sky may be accounted for by the scattering produced by the molecules of oxygen and nitrogen in the air entirely independent of the presence of dust, aqueous vapor, or other foreign matter.

From these and other observations and investigations it is evident that the color of the sky is independent of the angular distance of the point observed from the sun—being a function of only the state of the atmosphere and the thickness of the stratum observed. Careful observations on the color of polarization of the light from the sky, therefore, supply data determining the amount and size of the particles floating in the air, be they dust or water, and as any change in the state of the atmosphere will affect these quantities, such observations should be of ever-increasing importance to meteorology.

A NEW SEMI-DRY BATTERY.

The use of dry batteries in the operation of many devices, for open-circuit work, has so greatly extended that it is said in the United States alone about ten million cells are annually consumed.

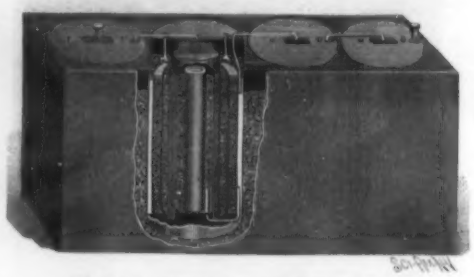
It has been observed, however, that there is a certain continual deterioration going on, even when the battery is not in use, which causes a variation in the output of amperage of current to such a degree that not more than half the quantity is given out at the end of a few months as when the battery was first made.

Despite this fact the dry battery is extremely popular on account of its convenience, cleanliness, portability, easy application and inexpensiveness.

Within the past few years much study and prolonged experiment has been given to the improvement and efficiency of the dry battery, resulting in the production of an improved form called the "Hydra Double Battery," which is a sealed semi-dry cell and is the subject of our illustrations.

This battery has been in successful and growing use in Germany and other foreign countries for the past four years or more and has largely supplanted many other kinds of batteries. It is the invention of Prof. Paul Schmidt, Carl Koenig and Robert Krayn, and combines the best proportions and balance of materials calculated to produce the highest efficiency in the steadiness and volume of current under the most exacting circumstances. It received the highest award and gold medal for batteries at the Paris Exposition.

Referring to the illustration of a section of single cell and beginning at the center, *A* is a cylinder of zinc closed at the bottom end and open at the top, holding in its interior a special liquid electrolyte, and is also connected by an insulated wire, *F*, to the outer thick zinc cylinder, *E*. The zinc cylinder, *A*, it will be observed, is placed within the carbon cup, *C*, with an absorbent paste depolarizer, *B*, between the two surfaces, the cup having a terminal at its upper end and its lower open end sealed up with pitch through which wire, *F*, passes. Outside the carbon cylinder is a dry-pressed generating depolarizer, *D*, inclosed in a network of linen, which is encircled by the outer zinc, *E*, from which the other terminal rises to the top of the cell. Over all the elements at the top is sawdust and absorbent cotton, and from this rise vent tubes, *G*, which pass through the asphalt top. The whole is inclosed in a thin outer metal casing insulated from the outer zinc cylinder, *E*, by which the battery is protected from dampness and other injury. A small chamber in the carbon cylinder, *C*, at the top just above the inner zinc, *A*, allows the electrolyte in latter to overflow occasionally and keep the absorbent paste, *B*, slightly moistened. The moisture thus absorbed passes from *B* through the porous carbon, *C*, to the dry absorbent, *D*, thereby maintaining it in proper condition for the generation of a current when the terminals of the battery are connected. The perfectly dry condition of the generating depolarizer, *D*, prevents any local internal action when the cell is not in use. The double surface of zinc provided by having an inner and outer zinc cylinder, as well as the depolarizing material on the inner and outer side of the carbon cylinder, give the battery a remarkably constant voltage, low internal resistance and high capacity, with the added advantage that the moist electrolyte is brought to the relief of the decomposing paste, keeping it permanently humid, giving the cell excellent power of recuperation after long use. The larger sized single



AN AUTO HYDRA SPARKING BATTERY.

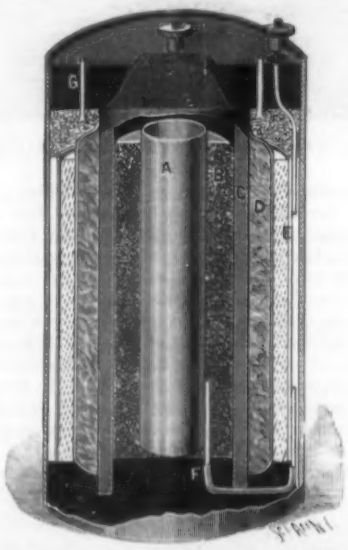
cell has an initial current of 22 to 30 amperes at 1½ volts.

In another view is a group of four cells in a rectangular metal case arranged for use in connection with a sparking coil for automobiles or gasoline engines. The largest size gives a discharge of 30 amperes at 6 volts.

We have had a set measuring 11 inches long, 7 inches high and 2 inches wide of this kind in use on a yacht, sparking a gasoline engine with very satisfactory results.

We have also seen a group of these batteries operate an electric fan very successfully, also portable miniature electric flash lights and gas lighters. Its constancy of output of current is one of its special features.

The manufacturers, who control the battery for the American continent, are the Hydra Double Battery Company, 32 Broadway, New York, which is composed of a number of well-known successful business men, and we are advised that they are introducing a special return system of used-up batteries and allowing reasonable compensation therefor. They also guarantee the capacity of every battery they make.



THE HYDRA DOUBLE SEMI-DRY BATTERY.

There is no question that a battery of the character described should come into general use and prove very effective for all classes of open-circuit work.

A painstaking inventor has devised an apparatus for measuring the vibration of a telephone transmitter by means of a ray of light reflected from a small mirror cemented to a steel pinion set in watch jewels, says The Engineer. To the center of the diaphragm is soldered a needle which presses on a steel arm. This arm is perpendicular to the pinion and in the plane of the mirror. The slightest vibration is transmitted through the needle and arm to the mirror, causing it to oscillate and thus deflect the beam of light. In an experiment a diaphragm excursion of one three-thousandth of an inch deflected the spot of light on a screen 25 feet away 2 inches. The ticking of a watch gave noticeable deflections, and loud sounds produced deflections of 2 feet.

THE FAILURE OF THE BROOKLYN BRIDGE.

The collapse of a portion of the Brooklyn Bridge during the recent hot weather was a serious event, that might easily have become a great public calamity. It is best to recognize this fact. For several hours, and for aught we know, for several days, a portion of the northern roadway of the bridge, measuring 70 x 30 feet, was entirely detached from its supporting cable and was only held up by the indirect support which it derived from the adjoining floorway. The case is analogous to that of an upper floor of a house from which the front wall has fallen out, which, in spite of the fact that the support on one side of the floor is gone, is still held up in a sagged condition by the natural resistance of the floorway to bending. There is this difference, however: the three remaining walls of the house will hold the floorway indefinitely, or until it decays, whereas, in the case of the Brooklyn Bridge there was an enormous increase of load thrown on the nearest suspenders to those which gave away, and with every fresh suspender that broke, the load was proportionately increased upon those that remained. We do not hesitate to say that, had a few more adjacent suspenders failed, the floor under the north cable would have ripped from the cable with a cumulative action throughout the whole length of the main span of the bridge.

As everybody knows by this time, the accident was due to the breaking of certain suspenders (nine in all) on the most northerly of the four main cables of the bridge. The immediate question to be solved is that of the actual cause of this failure. One of the engineers of the bridge has given out that it was the excessive heat. This is only partly true. The excessive heat was the occasion but not the cause of the disaster. The direct cause is to be found in faulty construction, coupled with the action of the elements. And let it just here be clearly understood that, in spite of the increased load which has been put upon the bridge, it is an absolutely safe structure as regards the four great cables themselves. The suspenders, moreover, by which the roadway is hung from the cables, are amply strong to carry even their present loads, provided these suspenders are subjected only to the simple pull or tensional strain for which they were designed. The floor system (including floor beams, stringers and stiffening trusses), though of antiquated design, and not at all of the kind that would be built in a modern suspension bridge, is sufficiently strong to carry with safety the present weight of the bridge, provided, however—and we cannot lay too much stress upon this—that it is subjected to a very thorough and frequent system of inspection in all its parts. We have said that the suspenders are amply strong for their work; but in saying this we draw attention to the fact that the method of attaching the suspenders to the floor system, particularly at the center of the main span, is poor and cheap in design, and liable to rapid deterioration unless it is carefully watched and frequently painted.

In general, the floor system is suspended from the main cables by wire cables which are spaced 7 feet 6 inches apart, there being a suspender located immediately above each transverse floor beam of the bridge. The suspenders for 30 panels on each side of the center of the main span consist of 2⅝-inch steel rods, these being used in preference to wire, because of the convenience in making connections. Connection is made to the main cables by means of a split steel band, between the ends of which an eye in the upper end of the suspender is bolted. The lower end of the suspender is threaded and passes down through a trunnion-block or rocker-bearing which is bolted beneath the floor beams, the amount of the load put upon the suspender being determined by screwing up the suspender nut against the underside of the block. The whole arrangement is shown clearly in the accompanying line and perspective drawings. It will be noticed that the suspender is free to have a pendulum motion parallel with the axis of the bridge, and in the plane of the cable to which it connects.

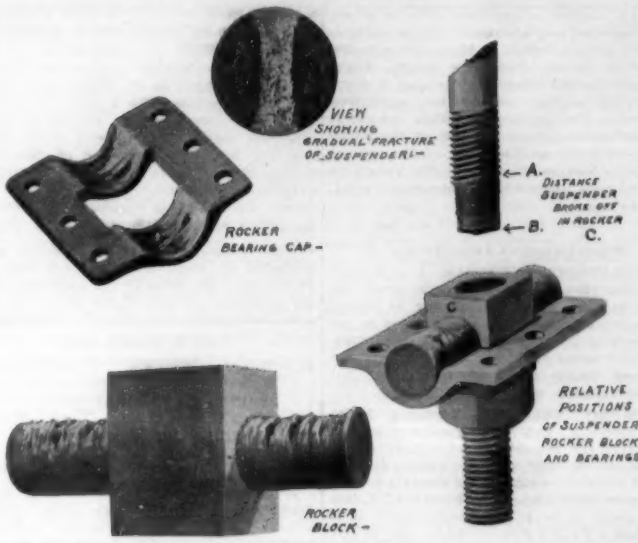
The object of using these "pendulum suspenders," as they are called, is to provide for the longitudinal movement of the floor system under changes of temperature. In the considerable range of temperature which occurs in New York in the course of a year it is found that, in the 1,600 feet of floor between the Brooklyn and New York towers of the Bridge, there is a maximum change of length of 14 inches. To provide for this the stiffening trusses are cut in two at the center and anchored firmly to the towers, an arrangement which results in the cut ends of the trusses moving together in the summer and drawing apart in the winter, the total horizontal movement of each truss being 7 inches. The main cables overhead, however, at this point are affected differently. Under an increase of temperature, they lengthen, and of course, sag toward the river. In the winter-time, contracting, they shorten and the center rises, the extreme rise and fall amounting to between 3 and 4 feet. Although the center of the cables has a considerable vertical movement, it has no movement in a horizontal direction, while the end of each truss has, as we have

seen, a maximum movement horizontally of 7 inches. From this it is evident that the suspenders, particularly toward the center of the truss, will have a pendulum movement in the direction of the length of the bridge, the top of the suspenders remaining stationary, while the bottom connection at the trusses will swing forward and backward, through an arc which will vary according to the changes in temperature. To this also must be added the vertical movements of the cable and the horizontal movements of the trusses due to concentrated loads passing over the bridge. The oscillations due to temperature changes are slow and comparatively imperceptible, those due to moving loads are more rapid, and they may be observed by anyone who will stand and watch the slip joint on each side of the passenger footway at the center of the bridge.

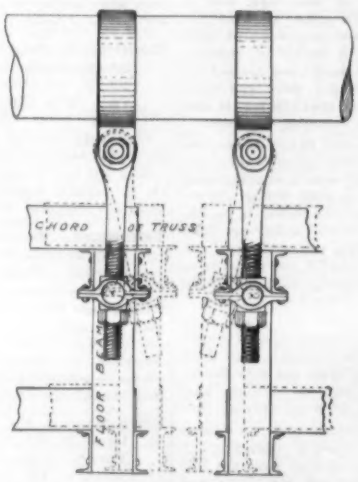
The longitudinal movement of the trusses necessitated some flexible or hinged joint where the suspenders make fast to the latter. The device adopted is shown in the accompanying engravings. It consists of a trunnion-block, whose trunnions rotate in cast-iron bearings which are riveted to the under side of the upper chord of the floor beams. The threaded lower end of the suspender passes freely through a hole bored through the trunnion block, and the strain on the suspender is adjusted by means of a nut underneath. In our line-drawing showing the slip joint in the truss, the dotted lines represent the position of the two ends of the trusses under the conditions of high temperature and local loading which produce the greatest extension of the trusses. As the maximum travel of each truss is 7 inches and the end suspenders are only 20 inches long, it will be seen that the trunnion-block must rotate in its bearings through a considerable arc, as the trusses move to and fro. If the frictional surfaces of the bearing are accurately turned and lined up, and if they are kept perfectly clean and thoroughly lubricated, the strain in the suspension rod will be simply one of tension due to the load imposed upon it; but it can easily be seen if the trunnion bearings should become rusted, or if foreign material would get into them, it would present enormous frictional resistance to turning, and a heavy bending strain would be thrown upon the suspenders.

We believe that originally it was intended to have these hinged joints lubricated; but it is certain that for a great many years no such care has been taken of them. The water has been allowed to run in, and there is no doubt that what with poor workmanship, severe rusting, and much heavier loading than was intended, the trunnions have turned with enormous resistance, and a heavy bending strain has been brought upon the suspenders, the bending being first in one direction and then in the other. These reverse strains would be greatest at the trunnion-block, and here unfortunately the rod is weakest, being cut away by the thread. Moreover, rainwater settling between the rod and hole in the block through which the rod passes, has rusted the metal badly on the threaded portion of the rod. It was only a question of time before these reversed bending strains caused fracture to commence at the root of the threads and work toward the center of the rods until the section of the remaining metal was too small to resist the natural tensional strain due to the load, and the rod parted. We present a correct drawing of the ends of one of the broken suspenders, showing how the outer portion of the metal was rusted, the inner portion showing a bright metallic fracture. The condition of this fracture, we consider, indisputably proves the truth of our theory of the cause of failure. Attention is drawn also to our drawing showing the deeply scored condition of the bearings, the trunnions of the rocker block being worn down from a quarter to three-eighths of an inch, and the cast-iron journals in which they were seated being also badly worn away. The deep scoring on the trunnions is due to hard spots in the cast-iron journals. The condition of these parts is an exceedingly interesting study to the engineer, and they tell the story of the breakdown with very strong emphasis.

The disastrous bending strains on the suspenders decrease as the suspenders become longer, for the reason that the arc of rotation is considerably less; but the amazing conditions of these central joints, as shown in our drawings, render it imperative on the part of the bridge authorities to inspect carefully every one of the total 240 suspenders at the center of the bridge, which are of similar construction. Not only should they be inspected, but some new and less crude design of connection should be put in. Care should be taken moreover to ensure a constant lubrication of the wearing parts, and the joints should be so covered in and painted that the destructive effects of the weather would be reduced to a minimum. As it is the weather has free play, and this important organic element of the bridge has about as much protection as a barn-door hinge.



DETAILS OF ONE OF THE HINGED JOINTS, SHOWING WORN CONDITION OF TRUNNION-BLOCK WEARING SURFACES, AND FRACTURE OF SUSPENDER BY BENDING.



SKETCH SHOWING, IN DOTTED LINES, MAXIMUM HORIZONTAL MOVEMENT OF TRUSSES, DUE TO SUMMER HEAT AND MOVING LOADS.

Glass Paving Material.

The Paris municipality is experimenting with glass paving material. The glass is submitted to a process called devitrification, which leaves a hard, smooth, opaque, non-porous substance which does not retain damp or odors and possesses remarkable resistance. Two of its drawbacks are its great expense and its resonance.

The Current Supplement.

The current SUPPLEMENT, No. 1335, opens with an illustrated article showing the very latest developments of Open-Hearth Furnaces. "Art Canons—Historic and Prehistoric" is by Prof. Thomas Wilson. "Recent Studies of Old Italian Volcanoes" is by Archibald Geikie. "Automobiling in the West" is by Charles B. Shanks, and is illustrated by seven engravings, showing how the motor carriage fought its way through the Sierra Nevada Mountains. "Charcoal Production and Recovery of By-Products in Germany" is an important technical article. "Is Alcohol a Food, a Poison or Both?" is a critical paper by Dr. John Madden. The Selected Formulæ column is devoted in this issue to "Cements and Lutes."

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BROOKLYN BRIDGE FROM THE NORTH, SHOWING BY ARROWS AT CENTER, LOCATION OF THE NINE BROKEN SUSPENDERS.

RECENTLY PATENTED INVENTIONS.

Engineering Improvements.

ROTARY ENGINE.—Henry F. Farley, Kalona, Iowa. The piston of this rotary engine has a yielding piston-head. In the cylinder a valve-abutment is mounted, having a cam-surface for pressing the piston-head. The abutment is hollow, is connected with the steam supply, and is arranged to open into the cylinder. Slide-valves control the amount of steam passing from each abutment into the cylinder at the time an abutment is in an inactive position. The engine is characterized by its simplicity and durability.

Mechanical Devices.

TURBINE WATER-WHEEL.—William W. Tyler, Dayton, Ohio. By reason of the improvements made by the inventor the cylinder-gate is completely balanced, and the pressure of the water tends neither to open nor to close the gate at any point of its position. The course of the water through the chutes is always smooth, and the water is not obstructed by the sharp edges of the gate projecting in the water course. Hence, the full power of the waterhead is utilized to the greatest profit.

MACHINE FOR MAKING PASTED TUBES FOR CIGARETTES.—Anatole Benoît, Julien Guériffet, and Jules Nicault, Rue Daguerre, Paris, France. The improvements which form the subject of the present invention consist notably in the particular construction of a tube-forming device, of a paste-distributer, and of a tucking device. These devices are combined so as to form a machine for producing a cigarette-tube which is pasted and closed at one end.

MOVABLE REGULATING RAIL FOR PIANOS.—Vital Bussière, 677 MacDonough Street, Brooklyn, New York city. In grand pianos, when the hammer strikes two strings in obedience to the pedal action, the hammer-felt is cut in; and when the hammer subsequently strikes the three strings the tone produced is uneven, as the third string receives a harder blow than the other two. In upright pianos the hammer-rail is moved toward or from the strings by the soft pedal—an arrangement which is defective since the lever on the hammer-butt is cut and worn in a very short time. To overcome these defects the inventor has devised a means for varying the distance between the heels of the jacks and the buttons in the rail. A richer tone is thus obtained—a tone which is permanent.

DUMPING-SCOW. — John M. Goodwin, Manhattan, New York city. The inventor has provided a simple means for causing the discharge and for preventing the careening of the scow. Cargo-carrying compartments of V-shaped cross section are provided.

SAWMILL.—James L. Grant, Johnson City, Tenn. By means of this sawmill quarter-sawed wood can be more effectively produced. A carriage is employed on which a log is held to turn around its longitudinal center, and a saw is arranged to cut radially into the log from the outer surface to a point near its center. With this machine a log can be sawed into fourteen sector-like parts. These parts can be cut into planks, each a full broad figure quarter-sawed.

EXPANSIBLE PULLEY.—John W. Hilland, Manhattan, New York city. The purpose of this invention is to construct a simple form of expansible pulley and to provide a means practically constituting a portion of the pulley whereby the driving-face may be quickly and conveniently increased or decreased in diameter, thus obviating variable motion.

CONVEYER MECHANISM.—Dr. Samuel M. Jenks, Madison, So. Dak. In the construction of the Jenks system of overhead-track, overhead-carrier, and overhead conveying mechanism, a radical departure has been made from similar contrivances. The most striking feature is to be found in the haul-rope. A permanent loop is made in the haul-rope; and this feature is the basic principle of the whole system. By reason of this permanent loop a direct draft is obtained in lifting the load. The merits of the direct draft are too obvious to require extended comment. The permanent loop is used in connection with a novel automatic interlocking sling-pulley. By reason of this pulley the amount of haul-rope required is reduced by 16 to 18 feet; friction is lessened; the haul-rope is prevented from twisting; the force necessary to return the empty sling and carrier, and bring the sling back to the load is diminished; and the strain on the haul-rope is so relieved that the two sections of the pulleys separate of their own weight. The Jenks steel-bar track differs from other tracks in so far as both legs of the angles are supported, stiffening the track far more than usual.

BICYCLE-RACING MACHINE. — Joseph Matthews, New Bedford, Mass. The purpose of the invention is to provide an apparatus for enabling bicycle-races to be conducted in a limited area, without the necessity of the machines' actually traveling over the distance supposed to be covered in the race. This end is attained by mounting the machines so that they do not move bodily and by transmitting the movement of a rapidly-spinning driving-wheel to a dummy-machine which travels on a small track. By these means the racing effect is obtained.

APPARATUS FOR UNLOADING CARS.—Watson Batchelor, Manhattan, New York city. The apparatus comprises a cradle poised at its middle and provided with a weight, the parts being arranged so that when a loaded car is run on the cradle the weight of the car will tilt the cradle. The car is thus thrown into an inclined position, whereupon the load may be discharged. When the car is unloaded the weight at the end of the cradle will assert itself to throw the cradle and car back to the horizontal position. The apparatus is particularly adaptable to unloading freight-cars into vessels.

Miscellaneous Inventions.

RAZOR-STROP. — William G. Mosier, Greenville, Miss. By means of the device invented by Mr. Mosier, a number of strops may be held so that when one strop is in use the others will not interfere with the operation of stropping the razor. Each strop may be turned readily from side to side so that the razor may be applied to either face.

TREE-PROP BRACKET.—Robert S. McIntyre, Riverside, Cal. The tree-prop bracket is arranged for movable attachment to a supporting-post at any desired point, and is adapted properly to engage and securely to hold the branch of a tree. The branch of a tree is not liable to be cut or chafed while it is supported.

AUTOMATIC BIB OR WATER-COCK.—Daniel H. Streeper, Norristown, Pa. The object of the invention is to provide a construction whereby the water-valve will be automatically operated by the water-pressure. The bib or cock is so constructed that it can be readily taken apart for cleaning. The construction is simple; the operation is efficient. Means are provided for regulating the flow of water.

SEALING-BUCKLE.—Ambrose F. Thompson, Hunter's Hill, New South Wales. The buckle is to be used on mail-bags, and is constructed so that the strap securing the contents of the bag cannot be unbuckled without breaking the seal. A buckle of ordinary construction underlies a metal bed for sealing wax, the bed having a flat floor and sides slightly raised so arranged that the buckle cannot be opened without breaking the wax.

NON-RESEALABLE BOTTLE.—Frank M. Weir, Monmouth, Ill. The inventor has provided a bottle, jug or jar with a simple means for sealing it after the original filling. When the bottle or jar is open the vessel is so disfigured that the rights of the dealer are fully protected and the purchaser insured from dishonest practices. The neck of the vessel is so constructed that an ordinary cork cannot be placed therein.

COT.—Albert A. Gregg, Buffalo, Wyo. Mr. Gregg has provided a cot which can be readily folded, and which, when extended, will form a more secure structure than the cots heretofore constructed. The cot is so made that it can be readily folded or set up for use.

ROLL FOR ROLLING-MILLS. — Caspar Hussels, Bruckhausen, Prussia, Germany. A core consisting of a tube of steel having a thin wall is arranged within the roll body and welded therewith. The core of the tube is cut a suitable length, and, when in place within the roller, projects at both ends outward, so that the projecting parts may be pressed at their extreme ends into the shape to fit coupling-crosses. The rest of the parts may be employed as journals. The rollers are cooled from the inside. The weight of the rolling-train is reduced; for the new rollers are considerably lighter than the old.

LAMP.—Charles E. Gervais, Manhattan, New York city. An electric battery is used in connection with this lamp, a heat or resistance coil being employed to ignite a primary wick, the flame of which is instantly communicated to the illuminating-wick. As soon as the illuminating-wick is ignited the current from the battery is switched off and the flame of the primary wick automatically extinguished.

BINOCULAR MICROSCOPE.—Joseph Kroulik, Rochester, N. Y. The optical axes of the two object-glasses intersect upon the stage. The distance between the two eye-pieces corresponds with the distance between a man's eyes. Each object-glass is provided with a separate tube in which a mirror is located to deflect the rays condensed by the object-glass to the eye-piece by a single reflection. Very effective stereoscopic vision and high magnifying and dissolving power are thus obtained.

NUT-LOCK.—Edward R. Campbell, East Ryegate, Vt. The nut-lock comprises a nut with a pawl in the nut designed to engage teeth on the thread of a bolt whereon the nut is screwed. A second pawl in the nut is arranged to engage teeth on the material to be secured by the nut and bolt.

FEED-BAG. — George A. Carleton, Jr., Edgewater, N. J. To avoid the great loss of feed occurring when bags of ordinary construction are employed, Mr. Carleton has devised a false bottom which is fed steadily upward toward the horse's mouth so as to keep the feed easily in reach of the animal and to avoid the necessity of the animal's throwing the bag up ward to reach the feed.

MARKING-TOOL. — Michael M. Clarke, Farmington, New Mexico. The marking-tool comprises a shank having a head at one end which terminates in a point and has its end face beveled. The cutting-lip on the head extends from the point rearwardly along one side of the head. The tool is arranged to make a perfect mark on the wood when drawn along the edge of a carpenter's square, straight edge, or like instrument.

MAIL-BOX.—Wesley O. Howe, Yonkers, N. Y. The object of the invention is to provide in connection with a mail-box a simple means for canceling the postage-stamp and otherwise marking the envelop while passing into the box. The operation of canceling a postage-stamp by this device is practically automatic. The time and expense now required for canceling stamps after collecting the letters are obviously saved.

Note.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

NEW BOOKS, ETC.

Electrical Designs. Comprising Instruction for Constructing Small Motors, Testing Instruments and Other Apparatus. With Working Drawings for Each Design. New York: American Electrician Company. 1901. 8vo. Pp. 262. Price $2.

A thoroughly practical book with working drawings on a satisfactory scale. The descriptions are clear and concise, putting the book in the class which is earnestly desired by electricians. It is illustrated by 289 figures.

The Practical Engineer Electrical Pocketbook for 1901. Manchester, England: Technical Publishing Company. 1901. Pocketbook form. Pp. 292. Price $1.

Works of this class are numerous, but there always seems to be room for another. The first issue of this book was well received last year. Considerable care and labor have been expended upon the present issue to make it even more worthy of popular favor. The tables will prove of special value.

Elementary Organic Analysis. Determination of Carbon and Hydrogen. By F. G. Benedict, Ph.D. Easton, Pa.: The Chemical Publishing Company. 1900. 12mo. Pp. 186. Price $1.

This little manual is presented in the hope that the descriptions and processes here recorded will aid in making the method of analysis by organic combustion more familiar and more satisfactory.

Taxidermy. Edited by Paul N. Hasluck. London and New York. 1901. 16mo. Pp. 160. Price 40 cents.

The little volume comprises the skinning, stuffing and mounting of birds, mammals and fish. It does not, of course, compare with the sumptuous works of Hornaday and other American writers, but it will doubtless prove useful to amateurs who do not wish to carry their knowledge of the art very far.

Field Manual for Engineering. By Philetus H. Philbrick, C.E., M.S. New York: John Wiley & Sons. 1901. 16mo. Pp. 401. Morocco, gilt. Price $3.

The aim in this work has been to present the subjects of the text in a mathematical and logical order, to classify all problems presented, and to express the resulting formula of every problem in the form requiring the least numerical computation; to furnish a large number of useful tables, and to treat the general problem of railway engineering more extensively than other similar works have done. The author has accomplished his task in an admirable manner.

Municipal Accounting. By F. H. Macpherson, C. A. Detroit, Mich.: The Bookkeeper Publishing Co., Ltd. 1900. 8vo. Pp. 46.

A comprehensive treatise on the subject of municipal accounts is here presented, illustrated by specimens of improved forms of books and reports, including sinking-fund and instalment, or annuity tables, for terms of two to thirty years, at rates of interest from 2 to 6 per cent, and other labor-saving tables.

A Glossary of Botanic Terms, with Their Derivation and Accent. By Benjamin Daydon Jackson. London: Duckworth & Co. 1900. Philadelphia: J. B. Lippincott Co. 12mo. Pp. 327. Price $2.

Neither the typography nor printing of this book is comparable with the text. A good glossary of botanical terms in handy form is badly needed, and the volume before us seems to have been prepared with great care.

Der Gips und Seine Verwendung. Handbuch. Für Bau- and Maurermeister Stuccateure, Modelleure, Bildhauer, Gipsgeiser u. s. w. Von Marco Pedrotti. 45 illustrations. Vienna: A. Hartleben. 1901. 16mo. Pp. 264.

The production of formaldehyde in the last few years has increased enormously; Germany alone produces yearly an enormous quantity, fully half of which is employed in the manufacture of anilin, while the remainder finds use in tanneries and paper factories. The present work is especially designed to meet the requirements of the chemist, physician-apothecary, and the technical manufacturer. The work explains clearly and concisely the method of manufacturing formaldehyde, its properties, and particularly the various uses to which the product may be put.

Business and Personal Wants.

READ THIS COLUMN CAREFULLY.—You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send you the name and address of the party desiring the information. **In every case it is necessary to give the number of the inquiry.**
MUNN & CO.

Marine Iron Works. Chicago. Catalogue free.

Inquiry No. 1096.—For jobbers of sporting goods, guns, etc.

Turbines.—Leffel & Co. Springfield, Ohio, U. S. A.

Inquiry No. 1097.—For parties to make castings for small locomotives.

"U. S." Metal Polish. Indianapolis. Samples free.

Inquiry No. 1098.—For hand and power machine for broom factories.

WATER WHEELS. Alcott & Co., Mt. Holly, N. J.

Inquiry No. 1099.—For manufacturers of a packing that will stand hot or cold weather.

Yankee Notions. Waterbury Button Co., Waterb'y, Ct.

Inquiry No. 1100.—For manufacturers of carriage bodies for the trade.

For Sale.—Patent. Johnson, 2 Masonic Temple, Cincinnati, O.

Inquiry No. 1101.—For a second-hand engraving machine for jewelry; also roller top watchmaker's bench.

Handle & Spoke Mchy. Ober Mfg. Co., 10 Bell St., Chagrin Falls, O.

Inquiry No. 1102.—For manufacturers of toys and puzzles.

Sawmill machinery and outfits manufactured by the Lane Mfg. Co., Box 13, Montpelier, Vt.

Inquiry No. 1103.—For manufacturers of small tempered brass springs.

For Sheet Brass Stamping and small Castings, write Badger Brass Mfg. Co., Kenosha, Wis.

Inquiry No. 1104.—For power freight elevators.

Rigs that Run. Hydrocarbon system. Write St. Louis Motor Carriage Co., St. Louis, Mo.

Inquiry No. 1105.—For hot air injectors.

Ten days' trial given on Daus' Tip Top Duplicator. Felix Daus Duplicator Co., 5 Hanover St., N. Y. city.

Inquiry No. 1106.—For machines for cutting paper stencils.

SAWMILLS.—With variable friction feed. Send for Catalogue B. Geo. S. Comstock, Mechanicsburg, Pa.

Inquiry No. 1107.—For manufacturers of steel enameled pans about 42 inches long by 15 inches wide, and 8 inches in depth.

Your advertisement on 1,000 gummed stickers, 50c. Agents wanted. G. E. Dunbar, 202 Main st., Malden, Mass.

Inquiry No. 1108.—For wood-turning lathes for making oval work, such as picture frames.

Koster Electric Mf'g Co's, Self-fluxing solder saves labor, strong non-corrosive joints, without acid. Chicago, Ill.

Inquiry No. 1109.—For lithograph embossed scrap pictures and fancy and colored edge cards.

Machine Work of every description. Jobbing and repairing. The Garvin Machine Co., 149 Varick, cor. Spring Sts., N. Y.

Inquiry No. **1110.**—For a general line of novelties.

See our Collective Exhibit—Section "S," Electricity Building, Pan American Exposition. Standard Welding Company, Cleveland, Ohio.

Inquiry No. 1111.—For manufacturers of children's toys.

For Sale.—New process for making oil with fish and fish offal is offered for sale or licenses in United States of America. Address Foreign, Box 773, New York.

Inquiry No. 1112.—For manufacturers of beer bottle stoppers.

For Sale.—Combination pocket dime bank, penknife, bill holder and match safe. Patent applied for. Address John Tanner, 112 N. 4th st., Paterson, N. J.

Inquiry No. 1113.—For a second-hand marine engine, about four horse power.

The celebrated "Hornsby-Akroyd" Patent Safety Oil Engine is built by the De La Vergne Refrigerating Machine Company. Foot of East 138th Street, New York.

Inquiry No. 1114.—For a small family ice machine.

The best book for electricians and beginners in electricity is "Experimental Science," by Geo. M. Hopkins. By mail, $4. Munn & Co., publishers, 361 Broadway, N. Y.

Inquiry No. 1115.—For manufacturers of kites for lifting flags, cameras, etc.

For Sale.—Astronomical telescope, silvered glass reflector, 6½ inches aperture, perfect definition guaranteed, equatorial stand. Very moderate price. Address P. O. Box 115, Mystic, Conn.

Inquiry No. 1116.—For electric hoists for ware houses.

The Australian Commercial Agency will undertake a few manufacturers, or other sole agencies. Thorough knowledge of Australian trade. Highest references. The Australian Commercial Agency, 109 Pitt street, Sydney.

Inquiry No. 1117.—For the manufacturers of the "Hold fast" skirt supporters.

Wanted.—A thoroughly competent engineer to push in United States of America a new, efficient and economical process, for dealing with large benefit towns' sewage and refuse waters from industry. Address France, Box 773, New York.

Inquiry No. 1118.—For a 24 to 30 inch drill press.

Wanted.—Agents to handle blocks of territory for our new, improved gasoline lighting system designed for commercial lighting. Gives better light than electricity at less expense to operate than oil lamps. Money maker for right parties. Address improved Gasoline Incandescent Light Company, Ltd., Howell, Mich.

Inquiry No. 1119.—For machinery for mixing and filling cans of baking powder.

Persons interested in patents of merit are hereby invited to inspect Daggett's safety trolley for use on electric cars. It prevents trolley pound, runs smoothly, does not jump the wire, is easy on the wires. Daggett's safety trolley prevents accidents. Its merits have been proven by actual use on three different lines. This patent, No. 658245, is for sale. Reference by companies using this trolley. Call or address Wm. A. Daggett, 116 W. Boulevard, Vineland, N. J.

Inquiry No. 1120.—For seamless steel tubing 1-8 to 5-16 inch bore.

Sheet metal, any kind, cut, formed, any shape. Prompt work. Metal Stamping Co. Niagara Falls, N. Y.

Inquiry No. 1121.—For a buttonhole moistener and opener, preferably Miller Brothers.

Inquiry No. 1122.—For handles for rubber stamps.

Inquiry No. 1123.—For centrifugal gold-separating machinery.

Inquiry No. 1124.—For machinery for powder mills.

Inquiry No. 1125.—For an automobile lawn-mower (gasoline preferred) with detachable roller.

Inquiry No. 1126.—For manufacturers of cigarette cardboard boxes.

Inquiry No. 1127.—For flexible steel ladder suitable for portable fire-escapes.

Inquiry No. 1128.—For a concentrator.

Inquiry No. 1129.—For manufacturers of printing presses, also type for same.

Inquiry No. 1130.—For manufacturers of paper for printing purposes.

Inquiry No. 1131.—For machinery for making toothpicks.

Inquiry No. 1132.—For machines for making linen collars.

Notes & Queries

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publ cation.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.

Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.

Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(8283) F. H. O. asks: What effect, if any, has a draught during a thunderstorm? Does a draught act as a conductor or in any way tend to change the direction of a lightning stroke? A. We cannot decide this matter. If doors and windows are open during a thunderstorm, the air is continuous and the path of the flash is direct through the openings into the house. Doors and glass are better insulators than air, and we feel protected to a greater degree when doors and windows are shut than when they are open. There is little scientific basis for this feeling, we are aware, but having it we shut the doors and windows.

(8284) J. S. C. asks: 1. What is the lifting power in pounds of one cubic foot of the gas used in balloons? A. The lifting power of any gas is the difference between the weight of the gas and the weight of the same volume of air. Since these weights vary with the temperature and the pressure of the atmosphere, it is common to give them for the freezing point and the normal barometer, 29.92 inches. The French aeronauts work upon the basis that one cubic meter of hydrogen will lift one kilogramme, and ordinary illuminating gas will lift about one-half as much as hydrogen. If a closer value is desired, it may be obtained as follows: 1 cubic foot of air at freezing and normal pressure weighs 1.29 ounces avoirdupois; 1 cubic foot of pure hydrogen under the same conditions weighs 0.089 ounce avoirdupois. The difference between these two weights is 1.2 ounces, which is the weight that 1 cubic foot of hydrogen will balance in the air. It will lift any weight less than that. Illuminating gas is of varying composition. If its density is taken at 0.458, its weight is 0.59 ounce per cubic foot, and 1 cubic foot of gas will balance a weight equal to the difference between 1.29 ounces and 0.59 ounce or 0.70 ounce. 2. What is the lifting power of a perfect vacuum (per cubic foot) if such could be obtained? A. The question is already answered above. It is 1.29 ounces per cubic foot, the weight of the air in a cubic foot. 3. What is the approximate weight per square foot of the gas holder of a balloon? A. We do not know. It varies greatly according to the material employed and the number of coats of varnish it has received. The total weight of bag and outfit is much more important.

(8285) R. E. M. writes: I am somewhat interested in some lead land in this part of the country which is as yet undeveloped, and with a view of starting to work on same at an early date, I write to ask you of your opinion of the electrolytic process of treating ores as compared with the stamp mill and smelter process. I understand there has been an electrolytic process whereby lead ore can be treated by electricity and a much larger per cent of the assayed value of the ore can be obtained than by the old method. A. Electrolytic processes are very rapidly coming into use and superseding the older methods of refining and smelting. We have not published any data upon the matter. The machinery can be secured from any of the large electric companies, and any good electric engineer can operate the plant.

(8286) F. F. asks: Can German silver wire be used in place of copper wire on voltmeter in SUPPLEMENT 1215, if only 1-12 as much wire was used and wind it all on the bobbin? A. German silver wire may be used in place of copper if it be made to meet the same conditions as are specified for the copper wire in the description of the voltmeter.

(8287) E. N. asks: Kindly inform me in what issues of the SUPPLEMENT shunt-wound and induction coils for medical purposes are described. A. SUPPLEMENT, No. 600, gives the connections of a shunt-wound dynamo or motor, and No. 569 contains the instructions for making a medical coil. The price of each of these is ten cents.

(8288) G. S. W. writes: I wish directions for making an electric dynamo suitable for electrolysis and of such size as to consume at its full load nearly one man power. Have you the plans for one which will do this? A. Yes; in SUPPLEMENT, No. 161, price ten cents.

(8289) LeM. L. P. asks: Kindly give details of charging storage battery for automobile. The best current to use, voltage, amperes, etc. A. We recommend Salomon's "Practical Management of Accumulators," price $1.50 by mail, for the purpose you have in view. The chapter upon "Charging" contains 33 pages. It is obviously out of the question for us to give "details" on the point in this column.

(8290) E. H. R. G. asks: 1. What is the specific gravity of corn meal, and how is it ascertained? A. The specific gravity of corn meal would be the same as that of the corn from which it was made. This would differ with the sample, since the same bulk of corn does not always weigh the same. To ascertain the specific gravity of corn, weigh a quantity very exactly. Weigh it again hung in water, and find the difference between the two weights. Divide the first weight by the difference. The quotient is the specific gravity. The corn may be put into a wire basket or gauze bag and hung from the balance to obtain its weight in water. It must be thoroughly wet with the water before its weight in the water is taken. 2. Is corn meal heavier than water, and is not this the reason that it sinks when put into a glass or tumbler of water? A. Yes, to both parts.

(8291) L. H. H. asks: 1. Could you please inform me what is the voltage and amperage of one cell of Fuller battery? I have a ½ H. P. motor which requires 8 volts and 5 amperes to run it. Do you think 4 cells of Fuller battery would run it, giving that power? How long do you think they would run it on one charge? A. The motor requires 5 amperes at 8 volts. This is 5 x 8, or 40 watts; 746 watts are one horse power. Your motor is a little less than 1-18 horse power. You overrate it. Four cells of Fuller battery will not give 8 volts for any length of time after they are charged. Five cells should be used. To obtain 5 amperes discharge, the cells should be of the largest size. They would be run down in 6 to 8 hours so far that they could not furnish enough current to run full speed. 2. Do you think five cells of carbon cylinder battery charged with bichromate and sulphuric acid solution would run it six hours? A. Yes.

(8292) S. C. asks: 1. What should I use for the lining of the cells of the plunging bichromate battery described on page 394 in "Experimental Science" in the absence of gutta percha? A. Nothing will completely replace hard rubber for the cells of a battery. Glass cells are the next best, but they are fragile. Next to glass is a wooden box with a thick coating of asphaltum upon the wood of the box. This should be frequently renewed. 2. Which would be the most efficient way of connecting the cells of this same battery? A. If the battery is to be used for cautery, or for sudden heating, connect in multiple; if for power, connect in series.

(8293) I. M. A. asks: 1. Where can I get descriptive illustrated article on electric plants of the United States navy? A. No single article contains this information. It is scattered through the files of the technical electrical press for the last three years. 2. Name some good book on incandescent wiring that gives diagrams with full explanations as to putting in all kinds of switches. A. Herrick's "Modern Switchboards," price $3; Kilgour, Swan and Biggs' "Electrical Distribution in Theory and Practice," price $4; Walker's "Electric Lighting for Marine Engineers," price $2; Davis' "Standard Tables for Electric Wiremen," price $1; Noll's "How to Wire Buildings," price $1.50. All these are helpful in the various parts of the work.

(8294) W. W. P. asks: 1. Can lithium, calcium, barium phosphates, potassium and zinc be used in colored lights, and what salts of these elements, and which phosphates will give the best results? A. The chemistry of this inquiry seems to be slightly mixed, but it will not explode as some of the compounds would if they were mixed as badly. In general, it may be said that chlorides and carbonates of lithium, barium, strontium, etc., are used for colored lights. Phosphates do not seem to be adapted to such a use. 2. How are ammonia, sulphate of copper and oxychloride of copper ($Cu_4O_2Cl_2.4H_2O$) made commercially and in the laboratory? A. Ammonio-sulphate of copper is made by adding ammonic hydrate to a solution of sulphate of copper in water till the precipitate which is formed at first is dissolved. A clear blue liquid results. The oxychloride of copper is a common paint under the name of Brunswick green. For its manufacture consult works on the manufacture of paints. 3. What furnishes the oxygen necessary for combustion in the following: Chlorate of barium, 2 ounces; nitrate of barium, 3 ounces; sulphur, 1 ounce? A. All chlorates contain a large proportion of oxygen and are very unstable compounds, easily decomposed, often with violent explosions. It is from potassium chlorate that oxygen is manufactured for commercial uses. Nitrates contain three equivalents of oxygen. Potassium nitrate is used in the manufacture of gunpowder because of the oxygen it furnishes to consume the carbon and the sulphur. The compound whose formula you give is explosive. 4. I recently saw that "flowers" is the name applied to distillates, but I also saw that "floreszinci" is oxide of zinc. What, therefore, is flowers of zinc? A. We are not familiar with the usage of the word "flower" as a *distillate;* nor do we find any such definition given in Webster. It may be sublimate was used where you read distillate. In this sense of flowers, the word simply means a fine powder. Flowers of zinc is finely powdered zinc oxide as used by the druggist in preparing ointment. 5. Where can copper disulphide and mealpowder be bought, and how much does mealpowder cost? A. Apply to the nearest druggist.

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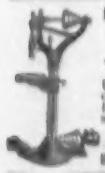

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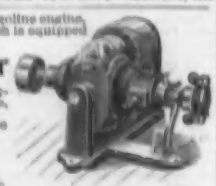

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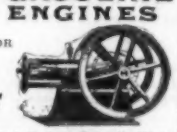

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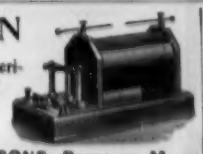

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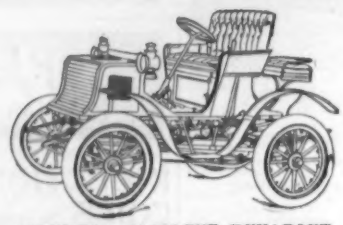

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